AUGUST, 1942

MAKING WHAT YOU NEED WITH WHAT YOU'VE GOT

Mix a maximum of engineering ingenuity with a minimum of time and only what equipment you can salvage from old breweries and shoe-polish factories and you have today's formula for making synthetic phenol. Read on pp. 76-9 how one company is making what it needs for use in essential plastics

MOUNTAINS OF DIATOMITE TO SERVE WAR INDUSTRIES

At the tip of California's Santa Ynez range lies one of America's most unique mineral deposits. Here millions of years ago Nature laid down a great supply of fossil diatoms which when properly processed serve the chemical engineer's needs for filter aids, fillers and insulation. See pp. 110-3

KEEPING WHAT WE HAVE BY FIRE PROTECTION

This month's Chem & Met. Report on Fire Protection in Process Industries emphasizes today's vital need for conservation of equipment and materials we already have through the best available methods of fire protection. As an example note the carbon dioxide system in the view at the left for flooding two tanks of methanol. See pp. 97-104

WASHINGTON NEWS pp. 118-119

Tube-Turn Welding Fittings are built to *stand the gaff* at the turns!

FASTER INSTALLATION WITH TUBE-TURN WELDING FITTINGS

In the above assembly, Tube-Turn welding fittings are speeding up the erection schedule and permitting a compactness of piping impossible if handled any other way. Also, their uniform wall thickness makes aligning and welding quicker and easier. Note the five Tube-Turn fittings in this small piping section: (1) a 90° elbow; (2) a tee; (3) another 90° elbow; (4) a lap joint welding nipple; (5) a lap joint flange.

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Chem & Met

NEXT MONTH

Practical information for the 1942-43 needs of chemical engineers will be the keynote of Chem. & Met.'s Tenth Materials of Construction issue to be published next month. In addition to handy presentations of data on abrasion-, heat-, and corrosion-resistant metals and alloys and revised information on non-metallics, the report will feature a group of three articles. These will tell how to get the most out of present irreplaceable materials, what are best substitutes for materials which formerly were used and now are unobtainable, and what the materials of construction situation will be like after the war.

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A McGRAW-HILL PUBLICATION

CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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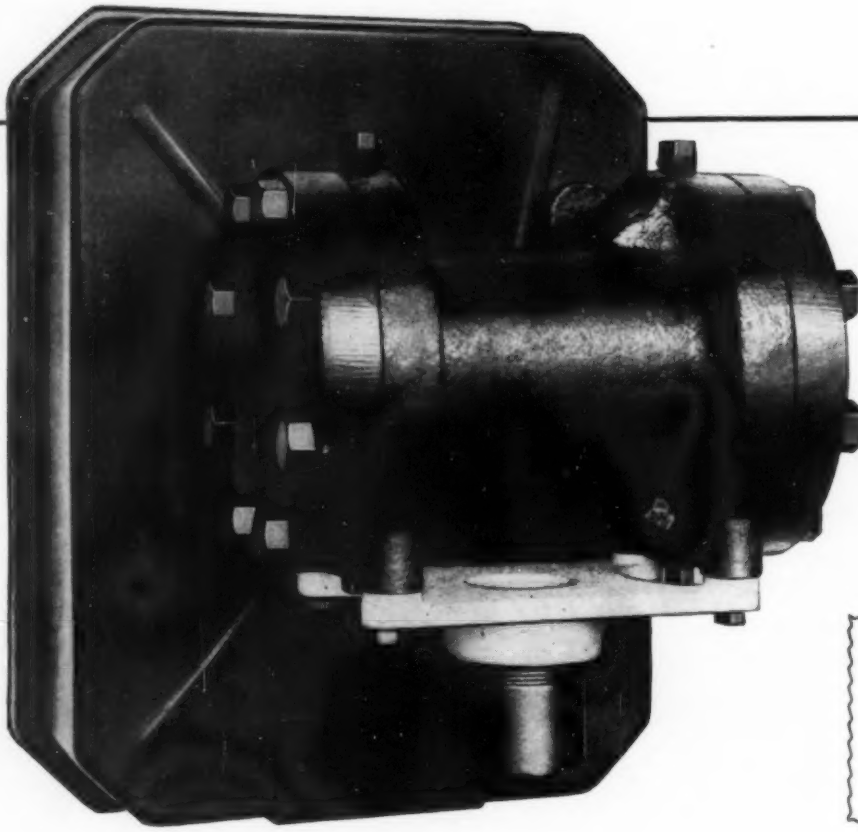

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CHEMICAL
& METALLURGICAL
ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

AUGUST, 1942

CONGRESSIONAL ENGINEERING

More chemical engineering, or what passes as such, is going into the *Congressional Record* than ever before in the history of that amazing publication. The newspapers are running a close second. Everybody except chemical engineers themselves seems to know just how the butadiene, alcohol, synthetic rubber and related problems are to be solved. There are partisans for every process as well as opponents for every proposal. The man in the street has become badly confused. He wants a new set of tires and he doesn't care much whether the rubber is farm-grown, processed from petroleum or coaxed out of coal. His homely advice is—"Quit talking and get going! Push all your processes as fast as you can and for all they are worth!" And, strangely enough, that is about the soundest advice we can get from any disinterested chemical engineers who are qualified to pass judgment. They say that only with the maximum effort and maximum success along many lines can we hope to meet even our most critical needs.

All agree that the rubber program has been badly mishandled, almost from the start. In the earlier stages there were mistakes of judgment in relying too heavily on the selling arguments of the Dutch and English syndicates, supported by certain promises of our own Navy. Then when the situation became serious, responsibility was divided between different governmental agencies whose negotiations were cloaked with unnecessary and suspicious secrecy. Congress stepped in and added to the confusion. The farm bloc saw an opportunity to push certain uneconomic and unorthodox proposals and did so to the extent of passing a bill to set up an independent agency to control that portion of the synthetic rubber program produced from farm and forest products. Thus the demands of the stronger pressure group in our farm-labor government were brazenly placed ahead of the public interest.

What was to be done? Apparently when President Roosevelt first asked himself that question, he hit upon the idea of putting the whole thing up to some man or group of men in whom the public would have fullest confidence. The findings of such a "Supreme Court" he felt might be accepted as the basis for a sound national policy. His selection of such men as Bernard Baruch, President Conant of Harvard and President Compton of M.I.T. meets with wide approval. With a business man and elder statesman in war industries as chairman and with both chemical and engineering talents ably represented, there should be a true appreciation of the three important phases of the rubber problem.

But it would be a great mistake, in our opinion, if the public is led to believe that the President's commission can or will pick any single process or raw material source as the sole basis on which we are to build our synthetic rubber industry. There are too many conflicting factors and variables to evaluate. The problem is so complicated and the responsibility so heavy that no possible group of "experts" can bring in a cut-and-dried solution.

Elsewhere in this issue is the announcement of the organization of a Referee Board of the Chemical Division of W.P.B. which is made up of twelve chemists and chemical engineers. Six of these men come from the faculties of American universities and six come from industry. None represents a single client, industry or viewpoint. There is wide geographical spread among their membership. None can claim expertness or experience in synthetic rubber industry. But despite such apparent qualifications, we feel certain that these men would not welcome, individually or as a group, any commission that would set them up as a tribunal to pass on a single solution for technical, economic and political problems involved in the present rubber situation. It is better that we work our way out, pushing all of our processes as hard and as fast as we can. The sum of all our efforts will not be too much nor too soon.

FROM AN

SETTING SOME RECORDS

According to the voluntary code of wartime practices established by the Office of Censorship, the American press is asked not to publish certain specific information "except when such information is made available officially by appropriate authorities." So we are particularly pleased to have as our "appropriate authority" Mr. Donald M. Nelson, whose official statement of July 26 had the following to say in reference to one of the jobs that chemical engineers are helping to do for their country:

> Explosives and ammunition are being made at many times the rate of last year as newly constructed plants come into operation. TNT is being made at a rate five times that before Pearl Harbor. Smokeless powder is being produced at a rate almost twice that before Pearl Harbor. One new plant is making more TNT than the entire explosives industry produced in peacetime and there are several of this type of plant.

Major General William N. Porter, Chief of the Chemical Warfare Service of the U. S. Army, told the American Legion at Asheville, N. C., on June 21 some things about the sort of bombs that General Doolittle's boys showered on Tokio. He said:

> By a miracle of production these bombs were rolling within a few weeks after we were in the war,—rolling not by the hundreds or even thousands, but by the millions—and this, I may add, with substitute materials where critical materials were being used for other purposes until production could catch up. I am proud of this achievement—proud of the thousands of men and women in the United States who cooperated in bringing it about. It was a tribute to ingenuity, industriousness and patriotism.

But we have only started. The fine records Mr. Nelson and General Porter have generously applauded will seem quite unimportant a few months hence when the enemies will feel the full force of our chemical program.

RUBBER AND RUBBISH

Elliott E. Simpson, the "independent" rubber man who recently announced that there are still millions of tons of scrap rubber lying around in the United States, is out to prove to the world that there is really no rubber shortage. It is merely a "myth" because (1) the stockpile of crude rubber in the United States is the greatest in history, (2) the Western Hemisphere contains many times more crude rubber in mature trees ready to be tapped than is available in all the trees of the Far East; (3) there are 200,000 sq.mi. of guayule bushes growing wild in Mexico besides a new domestic bush that can be grown any place in the south and can produce rubber in six months, (4) the United States has vast quantity of rubber extenders and chemicals cheaper than any other country in the world, and (5) synthetic rubber plants can be built to process rubber out of petroleum and alcohol available in greater abundance here than anywhere else in the world. Mr. Simpson wants it understood, of course, that he is in favor of the government's synthetic rubber program—"but only as good insurance." Against what, he doesn't say, but presumably it must be the "interests" that have been keeping the foregoing "facts" so secret.

Who is this learned man with such amazing information? He is the duly accredited and paid council of the Subcommittee of the United States House of Representatives Committee on Coinage, Weights, and Measures which is investigating the rubber situation! Having obtained the services of such a well-informed investigator there would seem to be no need for the subcommittee to hold hearings. Its members can now sit back and wait for Mr. Simpson to write his newest version of "Alice in Wonderland."

O.C.D. CHANGES THE SIGNALS

Just before the representatives of the American Institute of Chemical Engineers were to go on the air the other evening to discuss "Protection Against Incendiaries and Poison Gas," word came from Washington that our script would have to be

EDITORIAL VIEWPOINT

changed. It seems that recent research by the Chemical Warfare Service, confirmed by later experiences in Great Britain and New Zealand, had convinced the Office of Civilian Defense that it was all wrong to spray a burning bomb of the thermit-magnesium type. The new procedure called for a "direct jet of water"—a full stream from the garden hose rather than the coarse sprinkle of the stirrup pump. It emphasizes speed rather than precision as the quickest and surest way of putting the bomb out of action. After all, the fire that the bomb may start is more dangerous than the bomb itself. Only where highly flammable material may be sufficiently near the bomb to be ignited by the scattering of the burning magnesium, is the coarse spray recommended. Sand or other smothering agent is to be used "only if a bomb falls where it is not likely to start a fire, or if water is not available."

All this, despite its logic and directness, is just a little bit confusing. Thousands of air wardens have been giving lectures and reading articles and pamphlets based on several years of British experience. Many of us have witnessed very effective demonstrations of the older method. On the walls of the very N.B.C. studio in which we made our broadcast were explicit instructions to avoid a full stream while carefully spraying the burning bomb. But all that is now as obsolete as the various "standard" and "approved" types of spraying accessories we have all been urged to buy. Times have changed and, we hope, for the better.

INDUSTRIAL FIRE FIGHTING

FORTUNATELY no such fickleness characterizes the accepted rules and practices of fire prevention as developed for the protection of industrial property. Over a period of years, chemical industry has established a fine record in the face of serious fire and explosion hazards that are inherent in its processes and products. Now, more than ever before, there is need for caution, careful study and effective procedures for fire fighting as well as its prevention. The sort of information that we have concentrated in this month's report (see pp. 99 to 104) should be part of every chemical engineer's knowledge and equipment.

WASHINGTON HIGHLIGHTS

SHORTAGES of raw materials have become so severe that they are limiting war production in many lines. The situation will become worse before it gets better. Certain manufacturers are a bit worried over the reaction of labor when hours are cut down and incomes reduced by inability to get sufficient material for full-time operation.

No relief is yet in sight. In general, the country has more than enough fabricating capacity in many lines to absorb all of the materials available, and more. Someone has to say who is to receive materials and who will not. That's what decided the cancellation of the Higgins shipbuilding contract. It's also the major consideration in the synthetic rubber program.

Control of purchasing started a related controversy that hasn't yet been settled finally. The real issue at stake is whether the country's economy during wartime is to be run by civilians or by the military establishment. To date, the President is backing Don Nelson, but pressure from the military is enormous. The new WPB setup has got to work—or else.

SHIP BOTTOMS are still the critical, limiting factor, but despite reports to the contrary, no serious delays have been experienced in shipping the actual munitions of war to our allies. Tonnage available has improved during the last month to the extent that ships formerly carrying non-essential goods have been diverted to carrying war goods, and cross-hauls are being eliminated.

NO ELECTRIC power rationing is anticipated this year. For the first time in years the utilities, through the power section of WPB, have a neutral agency in Washington through which they may deal in planning expansion, interconnections and other steps necessary to make the most of the power resources we already possess. With the 5,000,000 kw. now projected, no critical power situation is visible anywhere on the horizon.

How One Chemical Concern Now Meets the War Emergency

JOHN R. CALLAHAM

Assistant Editor, Chemical & Metallurgical Engineering

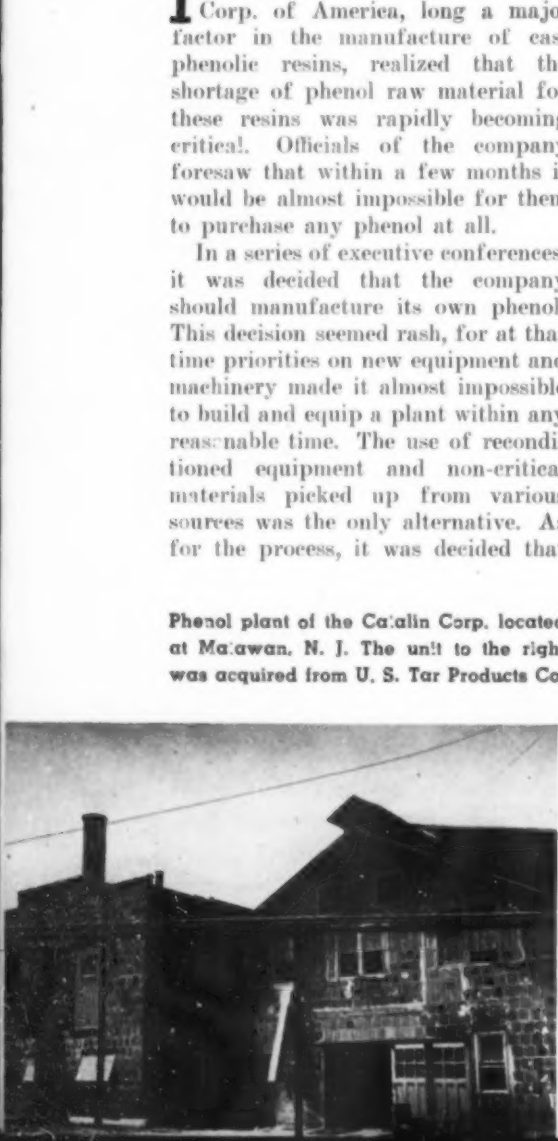
Chem. & Met. INTERPRETATION

Here is the story of how one enterprising chemical company which, when it found its regular source of purchased phenol raw material threatened by shortages caused by the war, used its chemical initiative and engineering ingenuity to erect and equip with a minimum of expense and time a plant to manufacture this raw material. Reconditioned equipment and non-critical materials of construction were used whenever possible, and work was principally done by the concern's own engineering personnel and shop facilities. —*Editors.*

In the Fall of 1941, the Catalin Corp. of America, long a major factor in the manufacture of cast phenolic resins, realized that the shortage of phenol raw material for these resins was rapidly becoming critical. Officials of the company foresaw that within a few months it would be almost impossible for them to purchase any phenol at all.

In a series of executive conferences, it was decided that the company should manufacture its own phenol. This decision seemed rash, for at that time priorities on new equipment and machinery made it almost impossible to build and equip a plant within any reasonable time. The use of reconditioned equipment and non-critical materials picked up from various sources was the only alternative. As for the process, it was decided that the sulphonation of benzene would, under the circumstances, be most simple and feasible and require the minimum of equipment.

Phenol plant of the Catalin Corp. located at Matawan, N. J. The unit to the right was acquired from U. S. Tar Products Co.



Accordingly, early in October the Catalin Corp. of America acquired certain buildings and facilities from the plant of the U. S. Tar Products Co. located outside Matawan, N. J. By the middle of October, construction was under way on new buildings to be used in conjunction with existing units. Meanwhile, reconditioned equipment was being picked up whenever and wherever available and modified to fit the processing needs at the company's maintenance shop located at Fords, N. J. Some equipment designed for other uses was converted and installed even before the final building was completed. Probably as much as 75 percent of the total equipment requirements were obtained from used machinery sources, as indicated in the accompanying flowsheet.

All engineering work, plant layouts, equipment reconditioning and installation of apparatus was done principally by the company's own personnel. Erection and successful operation of the synthetic phenol plant represents a considerable achievement, since the company had the time to conduct only very preliminary experiments and had little previous engineering experience with the process. No pilot plant or even large-scale laboratory work was conducted prior to erection of the plant.

By March of 1942 the plant was in production. Since that time it has continued to supply substantial phenol requirements of the company with a minimum of operating difficulties and delays.

COST AND CAPACITY

Total cost of the present plant has been estimated at less than half a million dollars. Officials of the company concede that only a war-time economy has made worthwhile the erection of the plant and use of this particular process. Considerable refinement and process improvements are contemplated, however, and operations will be continued even after the chemical world returns to normalcy. Meanwhile, however, the company continues to get considerable phenol and manufacture its regular line of phenolic resins for various essential uses.

Rated capacity of the plant has been placed at several hundred thousand pounds of U.S.P. phenol per month, representing several percent of the estimated total domestic phenol production for 1941. The plant operates seven days per week and employs a total of about 30 operating personnel for three shifts.

PROCESS USED

In brief, the process consists of the treatment of nitration grade benzene with oleum to produce benzene sulphonic acid, which is neutralized with sodium sulphite. The sodium salt thus formed is fused with caustic soda and the mass treated with water, yielding sodium phenate and sodium sulphite. The solid sodium sulphite is filtered off for re-use and the sodium phenate is acidified with sulphurous acid to give a crude phenol which must be distilled under vacuum to produce the U.S.P. product.

Primary raw materials for the

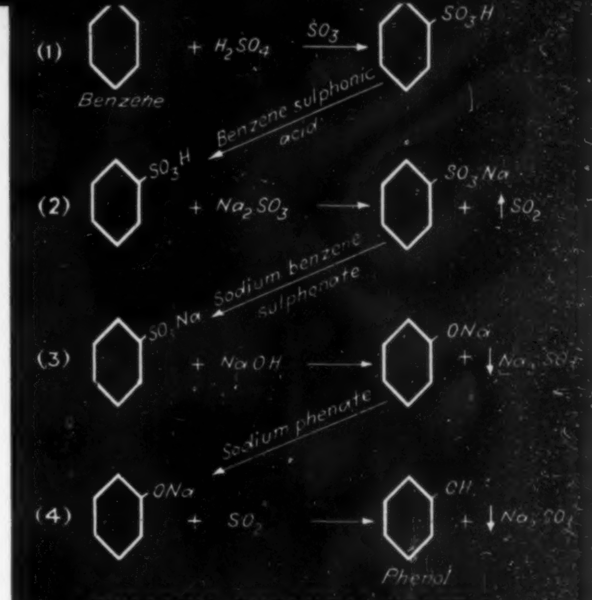
process are nitration grade benzene and 20 percent oleum. Previously, 26 percent oleum had been used, but trouble was experienced with the freezing of this material. Reconditioned riveted unlined steel gasoline tanks, housed in a separate building for safety, are used as storages for both benzene and oleum. Each of the two benzene storages holds 1½ tank cars of benzene, and each of the two oleum storages holds 1½ tank cars of acid. Oleum lines are lagged and traced with steam lines to prevent freezing, and benzene is handled by bronze pumps through iron lines for safety purposes. Pumps and valves throughout the plant are largely second-hand.

SULPHONATION PHASE

Sulphonation is carried out in a separate new building with a concrete bottom floor and wooden half-floor. Sulphonation tanks are shown in an accompanying photograph. This building is outstanding for its cleanliness and the precautions that have been taken to eliminate fire hazards. These include explosion-proof motors on the sulphonation units, fire blankets, and portable carbon dioxide fire extinguishers.

The two sulphonation kettles, each of 600 gal. capacity, are both of cast iron construction provided with 400 r.p.m. agitators of the propeller type. The units are unlined and are reported to have been used previously in the manufacture of shoe polish. The bottom half of each of the sulphonators has been jacketed at the company's Fords shop to provide for steam of 80 lb. pressure. Each reactor is provided with a benzene reflux tank equipped with cooling coils.

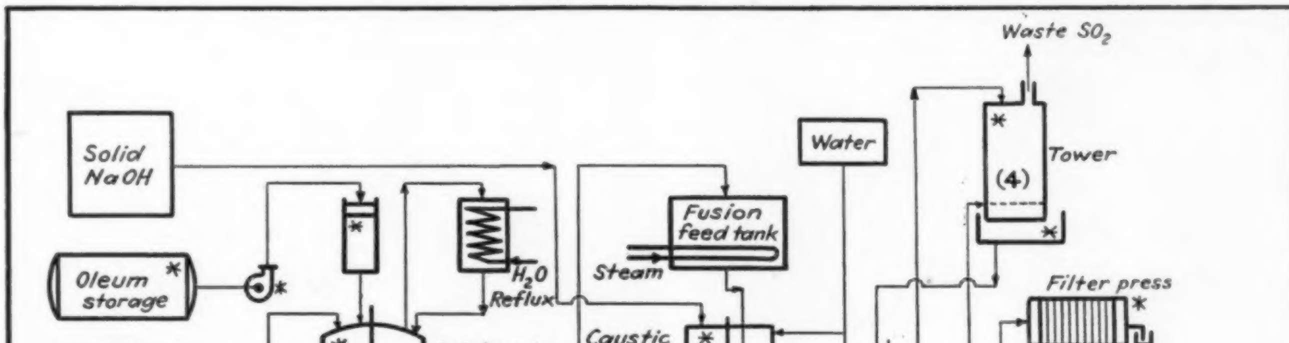
Benzene is metered into the kettles, while the oleum is fed into calibrated vessels formerly used as air compressor tanks. The full charge of benzene is first added at room temperature. Oleum in excess of that necessary for



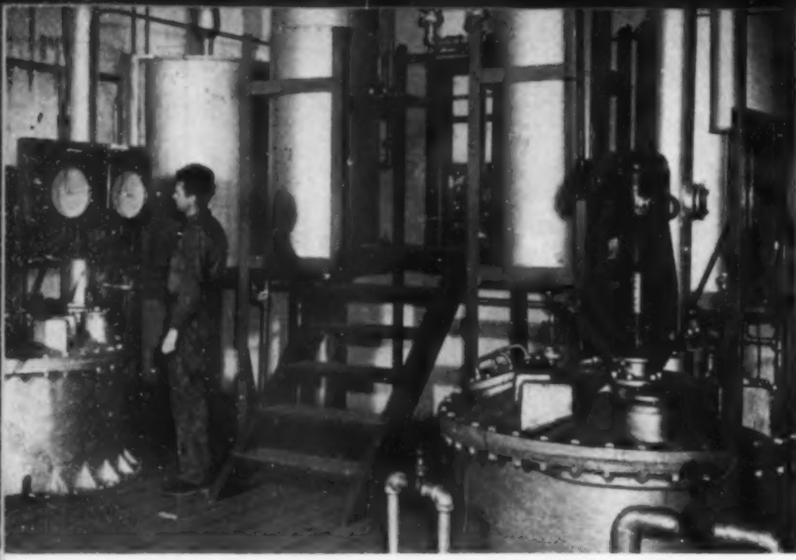
PRIMARY CHEMICAL REACTIONS

(Refer to flow sheet for location of each reaction)

The above equations show the primary reactions in the phenol process used by the Catalin Corp. Side reactions are not shown, nor are equations stoichiometric. The flow sheet below shows each step



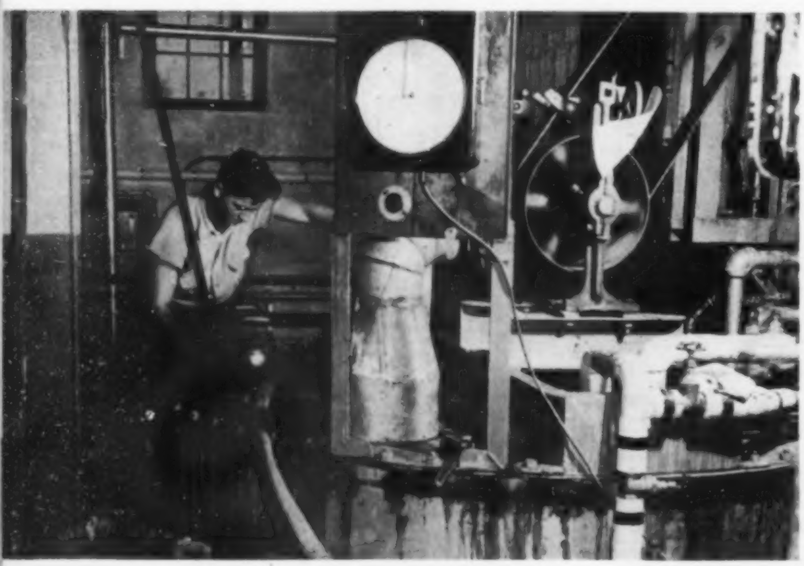
SIMPLIFIED FLOW SHEET OF OPERATIONS



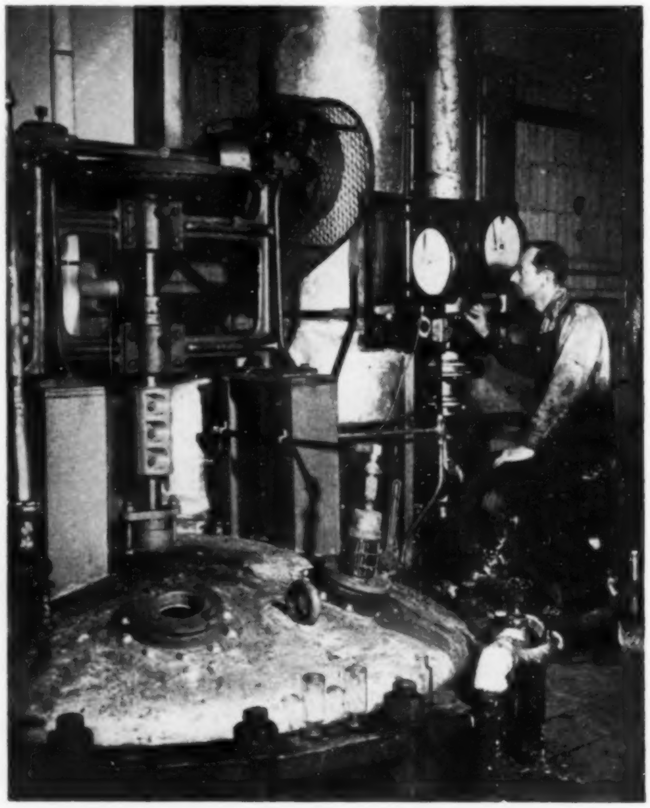
Left—Tops of the two benzene sulphonation kettles, showing temperature recorders, benzene reflux units and oleum feed tanks. Sulphonators are unlined, cast iron vessels formerly used for the preparation of shoe polish

Below—Converter tank, which is steel lined with lead and then with acid-proof brick. Here benzene sulphonic acid is neutralized with sodium sulphite to liberate sulphur dioxide

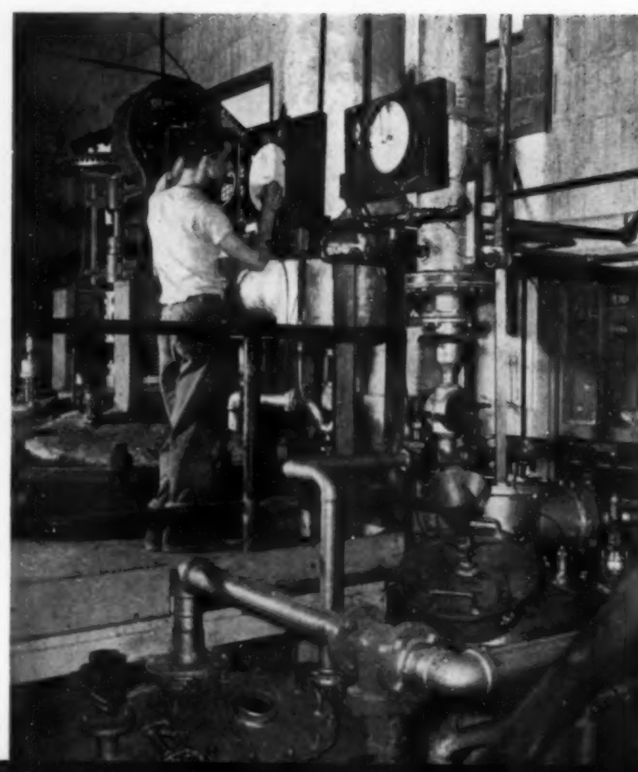
Below—This "springer" tank, provided with steam coils and a stirrer having bolted cast iron blades, is of unlined steel. Crude phenol (see reaction 4) is formed in this apparatus



Below—This reconditioned, jacketed still is of unlined steel construction. Phenol vapors pass upward through the fractionating tower to the right, which is packed with Berl saddles and provided with a dephlegmator and condenser



Right—Phenol still and, in the foreground, tops of the two pure phenol receivers. One of these is nickel-lined, while the other is glass-lined. Both were formerly used as resin kettles



the reaction is then fed in slowly over a period of several hours. Since the reaction between benzene and oleum liberates a considerable amount of heat (110 B.t.u. per lb. of reactants) it is necessary to add the oleum carefully and even at times to pass cooling water through the jacket so as to maintain the temperature of the reactants at about 95-105 deg. F.

BENZENE SULPHONIC ACID

When the heat of reaction has been absorbed, steam is added to the jacket and the mass heated until the final temperature is at 250-265 deg. F. Unreacted benzene starts to reflux and the reaction is complete in 2-3 hours. The reaction product, benzene sulphonic acid, has a specific gravity of 1.45 at 68 deg. F. and will solidify at room temperature. Hence it is necessary that lines to storage tanks be insulated and traced with live steam lines.

Benzene sulphonic acid, dark from iron impurities, is pumped from the sulphonation unit to the charging tank above the converter or "quencher", which is a steel tank lined with lead and then with acid-proof brick. Sodium sulphite from the following operation is added to the benzene sulphonic acid to form sodium benzene sulphonate, with the liberation of sulphur dioxide. Excess sulphuric acid from the sulphonation reaction forms sodium sulphate with part of the sodium sulphite. This reaction occurs first, after which the benzene sulphonic acid is reacted upon. The reaction is carried to neutralization, which requires 10-14 hours for completion. It is expected that this cycle will soon be shortened. No freezing must be allowed to occur. The mass contains 60 percent water.

Sulphur dioxide liberated at this point of the process passes up a stoneware tower packed with Raschig rings and flows counter-current to sodium phenate solution.

SALT CAKE BYPRODUCT

Slurry from the converter containing precipitated sodium sulphate and sodium benzene sulphonate is pumped through a pressure filter for removal of the sodium sulphate. This filter tank, formerly used in the manufacture of beer, is of steel construction and is provided with a wire screen filter upon which sodium sulphate builds up to a cake of 2-3 ft. in thickness. When sufficient cake has been built up, it is then steamed for several hours to volatilize residual sodium benzene sulphonate. The moist salt cake is removed manually by rakes and shoveled into a chute to the outside of the building.

Final characteristics of the salt cake are dependent primarily upon the time at which it is removed from the press. If it is removed while still hot and moist, the final cake will be granular and friable, while if it is allowed to cool in the press, it then becomes compact and hard. This salt cake carries the iron impurities precipitated with the converter slurry.

Filtrate from the pressure filter, containing the sodium benzene sulphonate, is then pumped to one of two evaporators, where the water content is lowered to about 50 percent by the use of steam coils. It is then pumped to one of two feed tanks above the caustic fusion pots. These feed tanks are provided with steam coils to prevent solidification.

CAUSTIC FUSION

The caustic fusion pots are redesigned cast iron vessels provided with horseshoe type agitators. They are heated at 610-660 deg. F. directly by two oil-fired furnaces and the solid caustic melts slowly for 2-3 hours. Process water is first added and then the sodium benzene sulphonate solution is fed slowly into the hot fused caustic to form sodium phenate and sodium sulphite. Evolved steam is vented to the atmosphere. The sodium phenate formed goes into solution while the sodium sulphite remains undissolved, since excess caustic soda serves to depress the solubility of sodium sulphite. The slurry of sodium phenate solution-sodium sulphite solid-excess caustic soda from the fusion pour tanks is pumped to one or two "springer" tanks. These two units are of steel construction and are provided with water and steam coils and a stirrer with bolted cast iron blades. They are also equipped with a heat exchanger tank for cooling the phenate charge.

Springer tanks, the quencher or converter and the SO_2 reaction tower are all operated in conjunction. Sulphur dioxide generated in the converter enters into the bottom of a stoneware tower approximately 12 ft. high and 3 ft. in diameter and packed with Raschig rings. The SO_2 flows upward counter-current to the springer liquor, which is pumped in at the top. This liquor, consisting of sodium phenate solution, solid sodium sulphite and excess caustic soda, is gassed by circulation through this tower until the pH has been lowered from about 11-12 at the beginning to 7.25. At this stage all of the sodium phenate has been converted into crude phenol, with formation of Na_2SO_3.

After the conversion is completed, pumping is ceased and the slurry is allowed to separate into three distinct layers. The first and top layer consists of dark brown crude phenol of about 85 percent strength. The second layer consists of straw-colored saturated sodium sulphite brine, while the bottom consists of white, crystalline sodium sulphite sludge.

The top layer of crude phenol is drawn off, passes through a second-hand filter press to remove any solid sodium sulphite, and then goes into a small crude phenol separatory tank. The bottom of this is conical and is provided with a valve and sight glass. The crude phenol and brine are here easily separated, since there is a clear line of demarcation between the dark brown phenol and the straw-colored brine. The brine is pumped back to the springer tank is to be recycled.

PHENOL DISTILLATION

From the separatory tank, the crude phenol goes to a used storage tank from where it is pumped to the phenol still. This is an unlined steel tank provided with a cast iron blade agitator and jacketed. Phenol is distilled off under vacuum and passes upward through a small fractionating tower packed with Berl saddles to separate the phenol from water. This tower is provided with a dephlegmator at the top and is followed by a small stainless steel condenser tower.

Located near the phenol still are the two pure phenol receivers. One of these is nickel-lined, while the other is glass-lined. These were formerly used as reaction kettles for the manufacture of resins at the Fords plant of the Catalin Corp. These receivers have been jacketed at the bottom for heating to prevent solidification of the phenol, which is now of the U.S.P. grade. From here the final phenol product is pumped to storage tanks, where it is ready for shipment.

Sodium sulphite slurry from the springer tank is sent to the steam still, another used piece of equipment, where it is steamed to drive off dilute residual phenol, which is returned to the process. The sulphite slurry is recycled in the process and returns to the converter for reaction with benzene sulphonic acid. Part of the excess sodium sulphite from the operations is marketed.

The writer would like to thank Mr. W. R. Thompson, technical director, and Mr. V. W. Moss, plant chemist, for their ready assistance and for aid in providing information contained in this article.

Combating Chronic Poisoning in Chemical Operations

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Chem. & Met. INTERPRETATION

In many plants the chemical engineer is called upon to pass judgment on the hazards which may result from the use of a certain chemical. These opinions are generally sound insofar as corrosion, explosions, contamination of product or acute poisoning are concerned. However, the probability of chronic poisoning is often ignored by many technical men. This may be due to faulty training as well as to the concentration of industrial hygiene literature in journals not widely read by chemical engineers employed in industry. —*Editors.*

Hazards of chronic exposure are hidden, difficult to detect, and the effects, besides requiring considerable time to develop, are greatly masked by individual differences in susceptibility. Yet it is chronic poisoning that is typical of the exposures encountered in industry, whereas technical and research men are usually exposed to poisoning of an acute nature. The employee working on an industrial job will be exposed to more or less the same conditions for years. On the other hand, the man doing experimental or research work may remain with one material only for a few weeks or a month. In many cases the man who has done development work assumes from his apparently short exposure to relatively high concentrations that the material in question is harmless. This premise may not be justified, since he may be particularly resistant to the material or there may not have been enough time for the development of chronic poisoning.

SPOTLIGHTING DANGERS

Something is necessary to make the hidden dangers of chronic poisoning stand out, for if the danger is recognized the hazard is already partly controlled. One recent development in accident prevention involves the spotlighting of danger points on machines by the use of color contrasts. A light color is used on and near the tool area and a darker shade for the remainder of the machine. The operator works more efficiently and with less hazard because the lighted tool area concentrates his attention on the work and also spotlights the danger spot. This color contrast alone has been sufficient to decrease the accident rate by 70 percent. Such results indicate the importance of calling attention to hazards and putting the spotlight on them. In the case of chronic poisons, it is difficult to detect the hazards except by chemical or physical means. There is usually no warning to the people who may be exposed.

Benzene poisoning is a hazard of this type. Even the name tends to conceal the danger since the material benzine, which is often confused with it, is comparatively non-toxic. Serious benzol poisoning may occur on jobs where men have worked for months without any discomfort or warning of any kind that they are exposed to dangerous fumes. Apparently without any reason, the accumulated effects of the exposure appear in the form of an anemia which is extremely difficult to treat. Even if the victim lives, he may never completely regain normal health.

Such chronic cases of poisoning, although much less spectacular, are more numerous and more serious than acute cases. The damage from repeated small doses of lead over a period of a year is more serious than that done by one short exposure to a very large concentration. Acute exposure produces serious effects and discomfort, but does not leave anywhere near the same amount of permanent damage.

There are comparatively few cases of industrial poisoning from materials such as ammonia, sulphur dioxide or hydrogen sulphide. This is because these materials are so disagreeable and so irritating that workmen are careful regarding their exposure. Cases are also rare with violent poisons, such as hydrogen cyanide and carbon monoxide. These materials are extremely poisonous and have very marked acute effects. Knowledge of their properties is widespread and precautions are usually taken wherever there is a possibility of exposure. The comparatively small number of cases occurring from hydrogen cyanide and from carbon monoxide, considering the danger, is very encouraging. It indicates that adequate knowledge in the hands of people who might be exposed will go a long way toward controlling the hazard. It is of utmost importance, therefore, that knowlledge regarding the possibility of chronic poisoning should be brought to the attention of the people who will be exposed to these materials as well as to those who design equipment for use with these chemicals.

INHALED POISONS

There is a considerable difference between the poisonings which occur in ordinary life and those which usually occur in industrial plants. Outside industry, most poisons get into the body by being swallowed. In industrial exposures the poisons are generally inhaled. There is quite a difference in the action of a poison, depending on whether it is swallowed or breathed. If a small amount of toxic substance is swallowed, there is a good chance that it can pass through the digestive system and out

This is the first of a series of articles designed to acquaint the chemical engineer with the hazards and prevention of chronic poisoning in industrial chemical operations. Other installments will deal specifically with heavy metal poisons, fibrosis-producing dusts, and toxic solvents.—*Editors.*

through the intestines with only small amounts being absorbed. This is particularly true with comparatively insoluble materials, such as lead. In the case of large amounts of poisons, the material may be rejected by the stomach. It is also possible that if some poison is absorbed the blood may be partially purified of the material in passing through the liver.

Thus, in ingested or swallowed poisons, some of the material may pass through the body unabsorbed so that all of the substance taken in does not necessarily contribute to poisoning. This, of course, does not hold for a soluble material such as sodium cyanide.

Dust fumes or vapors breathed into the lungs can only escape without absorption by returning the way they entered. Some of the material may lodge in the back of the throat and be swallowed. If the dust is very fine, a good portion of it may be breathed out again. However, the portion remaining in the lungs may be absorbed directly into the blood, which goes from the lungs to the heart and from that organ to every part of the body without first having to pass through the liver. It is apparent, therefore, that small doses which are inhaled are more apt to come in contact with the various organs of the body and to cause greater effects than materials which are swallowed.

Recognition of the dangers from inhaled dusts has contributed a great deal to the control of lead poisoning. For a number of years considerable emphasis was placed on personal cleanliness on the part of lead workers. Every possible source of lead ingestion was eliminated. Men were required to wash before eating and to take showers on leaving their jobs. They were also required to change their clothes and, in general, take any and every precaution to prevent any lead entering the body by the way of the mouth. The results from this control produced a very marked decrease in the number of lead poisoning cases. However, on certain jobs, lead cases continued to occur. With the recognition by lead companies that inhaled dusts were also very important and should be controlled, the number of cases fell off very rapidly.

INDIVIDUAL DIFFERENCES

One reason why engineers are often lulled into a sense of false security regarding certain materials is the fact that they may personally have worked with some of these materials for years without any ill effects. However, certain people are affected by drugs or poisons much more than others. A good example of this is the reaction that a group of people will obtain from drinking the same amount of alcohol. Certain people are affected by ragweed pollen; others are allergic to shellfish or strawberries, and others may have asthma when they come near a horse or a dog. It is difficult to explain these differences between individuals. We know, however, that of several men working on the same job and exposed to the same hazards, one may die and the others may not be affected at all.

A very interesting report which brings out this difference has been made by Captain Dudley of the British Navy. There were a number of cases of arsine poisoning on a submarine as a result of gas given off from the storage battery, the grids of which contained 0.2 percent arsenic. On one trip, 56 men formed a crew. Of this number, 30 were sent to the hospital, 15 were sick for a few days, 10 had very mild symptoms. One man did not feel any reaction. All of the men were exposed to the same amount of fumes for the same period of time. All of these sailors were presumably in good health and, considering that they were on submarine service, a picked group physically. However, the effects varied from the man who did not suffer any ill effects at all to one who was completely incapacitated for a short time. In some cases it was nearly six months before the blood count was up to normal.

There is also a case on record where four men were caught for a few minutes in a room full of ammonia fumes. One of these men died 15 minutes later, one man died after 24 hours, the third lived until the next day, and the fourth recovered completely.

In industrial exposures, it is very important to protect the most susceptible individuals. Some people are inclined to feel that if one man out of six or seven is affected by a given operation, then it is the individual's fault and no action is necessary to protect against this particular hazard. If it were possible to pick out the men who are resistant to a given poison, this attitude might then be justified. It can easily be shown experimentally that animals show differences in susceptibility to poison, but these differences cannot be attributed to personal habits.

CONTROL OF HAZARDS

In the control of lead poisoning, for example, some manufacturers have taken into account this difference in individual susceptibility. On jobs where the lead exposure might be near the borderline, blood examinations are made at periodical intervals to detect signs of lead absorption. This is detected by changes in the structure of certain of the blood cells. The initial indication of absorption does not mean that the operator has lead poisoning, but that a certain amount of lead is being absorbed into the system and that he should be removed from the exposure before definite symptoms develop. The same type of control is used in connection with benzol, where examinations of the urine will detect absorption of the material. In this way men can be removed from the exposure or conditions can be improved as soon as signs of absorption are encountered.

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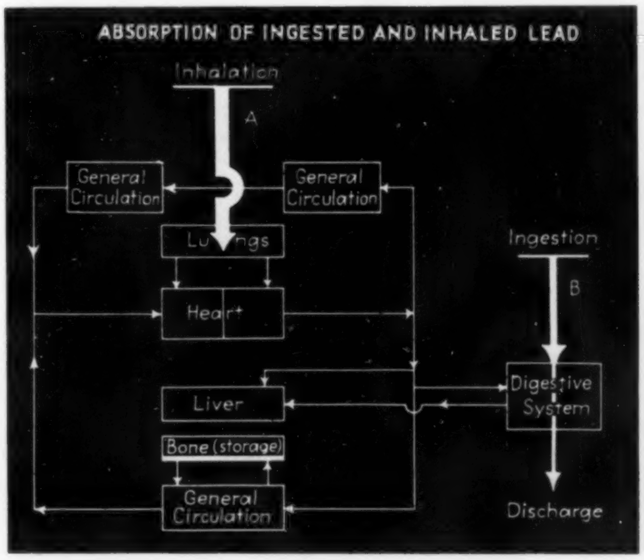


Motorizing Equipment in Hazardous Locations

C. W. FALLS *Engineer, Motor Division, General Electric Co.*

The necessity for speed in equipping plants for war purposes precludes development of special designs. Therefore, the chemical engineer who has the problem of motorizing plants producing or processing hazardous materials will find of value the author's suggestions and comments on the adaptability of standard types of motors that have been designed for somewhat similar conditions.—*Editors.*

The tremendous expansion of plants for manufacturing and handling explosive substances has swelled the demand for motors to be used in hazardous gas and dust locations. The technical literature in the past year or two has covered processes and materials involved in the manufacture and use of some of the more important military explosives, however, little has been published about the proper application of motors in hazardous areas of such plants. The best means of motorizing ammunition plants with types recently developed for somewhat similar conditions is a definite problem.

In some of these new plants the hazardous areas involve different substances presenting questions of selection of proper types of motors or decisions as to plant layout and motor location. An important factor in obtaining continuous operation, which is essential to the war effort, is the selection of motors suitable for the particular hazard involved. Motors must not be used in areas involving explosive conditions beyond the scope of their designs.

The more hazardous locations in ammunition manufacturing and handling plants, as well as those plants which produce chemical raw materials, may be classified broadly as (1) those involving flammable gases or flammable volatile liquids and (2) those in which highly explosive or combustible dusts are found. Such flammable gases and liquids, from which may come hazardous vapor-air mixtures, include acetylene, ether, hydrogen, acetone, alcohols, toluol, benzol and various petroleum products. Among the explosive or combustile dusts are starch, sulphur, powdered aluminum, magnesium, smokeless powder, and black powder.

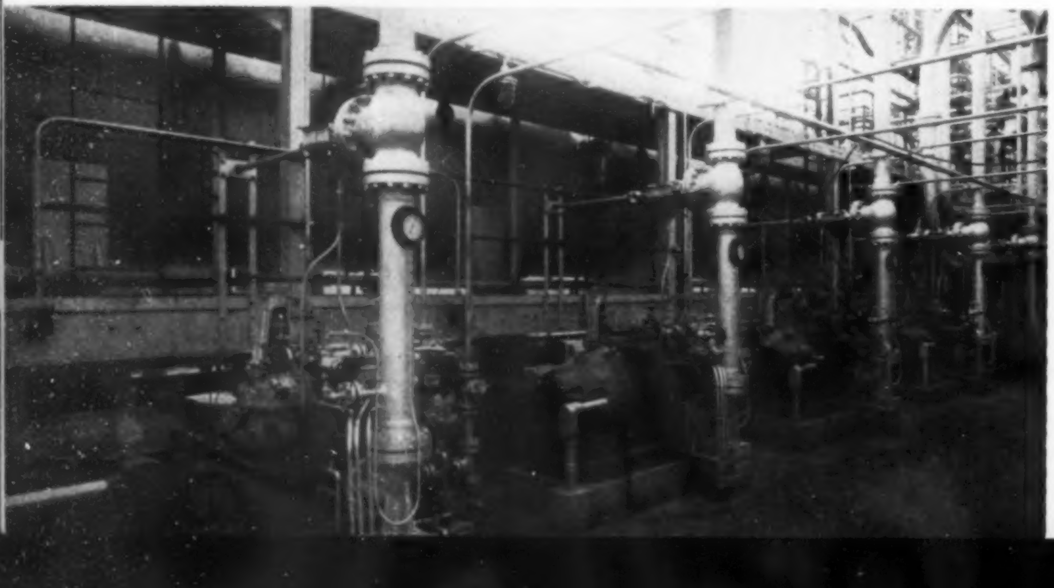
Some of these substances are definitely beyond the ability of the available motor designs, while others are well within the limits of present-day equipment. In the case of many of these substances, the successful use of motors within the hazardous areas is not particularly a matter of motor design, but depends largely upon the users' attention to such factors as: (1) avoidance of accumulations of the hazardous material on the motors, (2) selection and careful maintenance of proper types and sizes of overload relays, (3) proper layout of the distribution system, and (4) choice of breakers with adequate interrupting capacity.

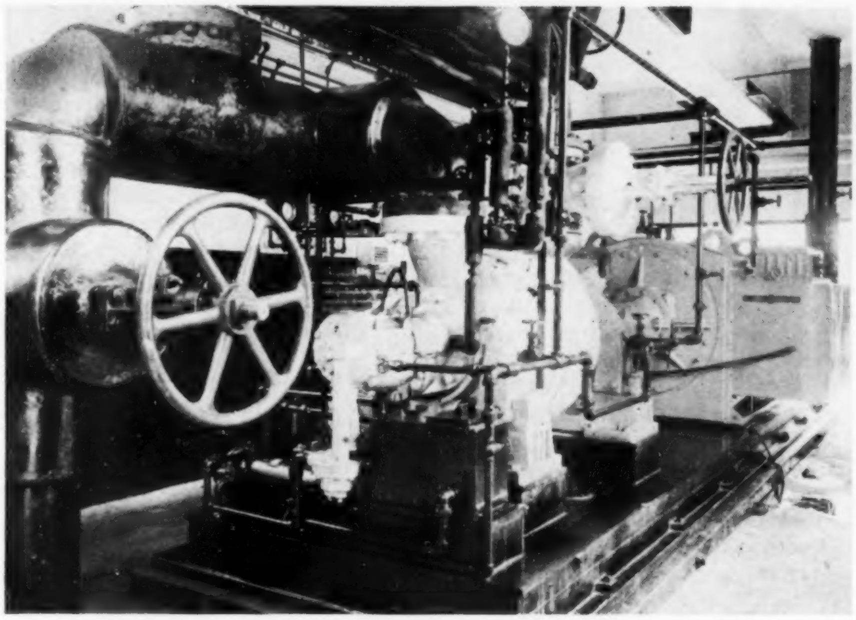
The necessity for speed in the erection and operation of these plants for war purposes has precluded the possibility of lengthy tests leading to the development of special motor designs best suited for each of the hazardous materials involved. It has been necessary to utilize the best motors available, in many instances using special arrangements of location or ventilation. In order to permit the most intelligent selection and application of available types of motors and to reach the best solution of the problems involved, particularly where new hazardous materials appear, it is necessary to have an understanding of the design objectives, construction features, and tests for suitability of the various types of motors for these plants.

The most obvious solution, but one which cannot always readily be carried out, is isolation of motors by locating them outside of the hazardous area so that they will not be exposed to the danger. This has been the practice for many years in parts of powder mills, particularly for the "corning" or "granulating" process where the driving motors have been located behind earthen barriers outside of the process buildings. In areas involving materials which have ignition temperatures approximating the normal operating temperature of the motors and where accumulation of the material on the motors cannot be prevented, isolation by walls, partitions, or enclosures of some sort is indicated.

Similarly, isolation is needed for hazardous areas involving gases, such as acetylene, that upon explosion may produce pressures of an order much higher than those for which industrial motors have been designed. This is also true in the case of gases like carbon disulphide, the ignition temperature of which approaches the normal operating temperature of a motor. Even though the motors are remotely located, it is usually good practice to use one of the totally en-

Explosion-proof motors each coupled to centrifugal pump operating out of doors in Texas oil refinery





Hot-oil charging pump in oil refinery driven by inert-gas-filled squirrel-cage induction motor with built-in heat exchangers

closed types as a means of minimizing the fire hazard.

It is not always feasible or practical to locate motors remotely or to isolate them from the driven machine and surrounding hazardous area. The nature of the driven machine and the desire to eliminate certain intermediate mechanical driving devices may call for locating the motors on or very close to the driven machines. There are several types of enclosed motor construction which are usually suggested for these applications. They include such constructions as (1) pipe-ventilated motors, (2) inert gas-filled motors, (3) totally enclosed Class II motors, and (4) Class I explosion-proof motors.

The National Electrical Code Classifies Hazardous Gas and Dust Locations as follows:

Class I, Group A, atmospheres containing acetylene;
Class I, Group B, atmospheres containing hydrogen or gases or vapors of equivalent hazard such as manufactured gas;
Class I, Group C, atmospheres containing ethyl ether vapor;
Class I, Group D, atmospheres containing gasoline, petroleum, naptha, alcohols, acetone, lacquer solvent vapors, and natural gas;
Class II, Group E, atmospheres containing metal dust;
Class II, Group F, atmospheres containing carbon black, coal or coke dust;
Class II, Group G, atmospheres containing grain dust.

Pipe-ventilated motors are relatively limited in their effectiveness for application in hazardous locations. Usually they simply are enclosed motors with air intakes and outlets arranged for accommodating pipes for ventilating air. When flammable gases surround the motor, gas accumulations and possible explosions on the inside may be prevented by passing clean air through it. Pipe ventilation obviously does not prevent accumulation of hazardous material on the outside surfaces of the motor frames and piping. Therefore, the heating of the motor under normal and abnormal load conditions must be considered. Furthermore, automatic fire extinguishing equipment within such motors and perhaps within the air ducts may be necessary to subdue internal fires and prevent heating of the exterior of the motor frame and piping.

Inert gas-filled motors, which are enclosed motors with auxiliary equipment to maintain gas under slight pressure within the enclosures, have been found useful in hazardous gas locations. Such motors in sizes above 400 or 500 hp. are particularly useful where it becomes increasingly difficult to obtain totally enclosed, fan-cooled explosion-proof motors. The enclosures are tight enough to require only a small supply of "make-up" gas, and the pressure prevents entrance of surrounding hazardous gas.

Enclosed Class II motors for use in combustible or explosive dusts are of totally enclosed construction, with or without fan cooling. Such motors are designed on the assumption that it is practical and relatively easy to make machines dust-tight and hence, dust explosions within these motors will not occur. Such motors also should be designed so that no external parts will spark or overheat under permissible overloads to the extent of igniting surrounding dust.

These design objectives have been obtained in motors for Class II, Group G, dust conditions by the use of tight joints with at least 3/16-in. metal-to-metal surface contact, also close clearances of bearing housing lips along the shaft, permanently sealed-in leads, nonsparking external fan material, relatively straight and smooth external ventilating passages (of fan-cooled motors) to prevent rapid clogging and to facilitate cleaning. The normal operating temperature of the motors in the usual ambient and with permissible overloads, is well below the ignition point of the specified dust.

It will be noted that Class II motors for combustible dusts are not necessarily explosion-proof, since it is possible to obtain dust-tightness as well as meet the other design objectives by relatively thin enclosing parts. It is true, however, that several motor manufacturers have taken advantage of their explosion-proof Class I motor development and simply submitted explosion-proof motors for dust tests rather than attempt a separate line of motors.

Tests for suitability of motors for Class II dust conditions are carried out by placing a motor in a test chamber and subjecting it to dust-air mixtures while the motor is alternately heated and cooled by loading and unloading. Cycles approximating several years of operation in an industrial plant are carried out before disassembly to observe whether any dust has entered the enclosure.

A second test is made in the same dust chamber for the purpose of determining whether the temperature attained when the motor is blanketed with a specified dust will be high enough to produce serious charring or ignition of the dust. Tests are conducted under full rated load, temperatures being measured by thermocouples and the dust in contact with the enclosure being examined for evidence of charring or ignition.

Tests of this sort have been carried out on motors as large as 400 hp., 1,800 rpm., to determine their suitability in grain dust (Class II, Group G) of the fineness found in elevators and similar locations. These motors have successfully passed such tests but their successful use for grain dust is predicated on proper maintenance to avoid excessive accumulations of dust on the motors, and particularly upon the selection and maintenance

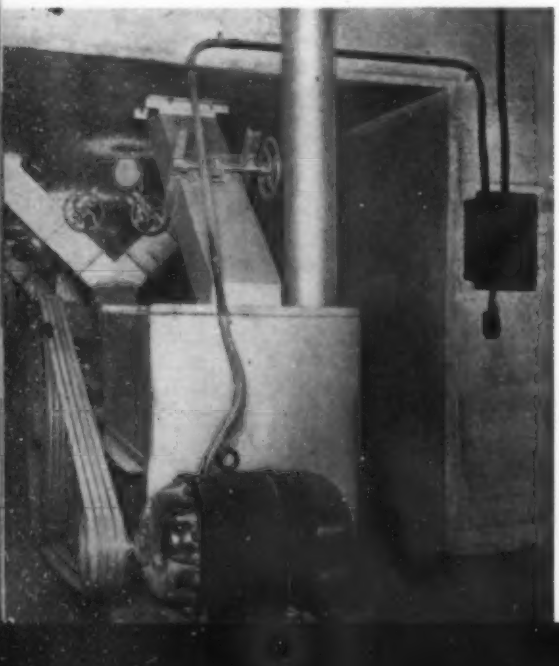
of suitable relays and short circuit protective devices to disconnect the motor immediately in case of excessive overloads, single phasing, or stalling.

Tests have also been carried out on designs of enclosed motors to determine their suitability in magnesium dust. As a result polyphase induction motors as high as 100 hp., single-phase motors up to 10 hp., and d.c. motors up to 30 hp. are now available for use in magnesium and in aluminum dust locations.

Where dusts of explosives such as TNT, black powder, and smokeless powder are encountered, successful use of Class II motors, in spite of their dust-tightness, will depend almost entirely upon proper relays, and upon maintenance which will prevent accumulation of such dusts on these motors. If these precautions can not be carried out, remote location outside of the dust area is necessary.

Explosion-proof Class I motors are totally enclosed, with or without fan cooling, designed and constructed to withstand an explosion of a specified gas, and prevent the passage of dangerous sparks or flame from the interior to the surrounding atmosphere. It is considered impractical to make usual industrial motors tight enough to exclude gas. Therefore, it is assumed that explosions can occur within an enclosed motor through failure of a winding or where a bearing failure permits rubbing of the rotating member against the stationary member. Consequently, an explosion-proof motor requires that all of the enclosing parts shall be strong enough to withstand an explosion of maximum intensity within the motor. Furthermore, the external parts of the motor should not spark or attain sufficient temperature under expected operating conditions to ignite the surrounding atmosphere.

Totally enclosed, fan-cooled, ball-bearing squirrel-cage induction motors, for class 2, group G, locations, each V-belted to conveyor in grain elevator



These objectives are accomplished in the explosion-proof motors already developed for Class I, Group D, conditions by utilizing enclosing frames and end shields, strongly reinforced where necessary, to give ample factors of safety. Flanged joints giving wide metal-to-metal fits with small clearances are used as a means of cooling the flame from internal explosions. Bolts of strong material and closely spaced are utilized, and holes with removable plugs are avoided. Leads are sealed with a permanent non-shrinking compound of adequate strength and depth to withstand explosion pressures. Interconnecting compartments of free air spaces within the motor are avoided so that successive explosions with precompression and consequent high pressures will not occur. External fans of non-sparking material are provided.

The development of explosion-proof motors has centered around Class I, Group D, atmospheres encountered in refineries, chemical plants, and similar establishments. Actual explosion tests fully demonstrating the suitability of motors for such conditions have been made on sizes as large as 500 hp. and 3,600 rpm.

Tests for suitability of motors in explosive gases are made by subjecting the motors to the specified gas or vapor-air mixtures over the range of flammable or explosive concentrations, so as to cover the maximum pressure effects and the maximum propagation effects of the specified mixture. To carry out such tests a motor is installed in a test chamber provided with gas inlet and outlet connections. The motor is also tapped with threaded holes for connection of inlet and outlet pipes for the explosive mixture, also for spark-producing devices and pressure-recording instruments.

The explosive mixture of accurately determined proportions is allowed to flow through the motor as well as in the test chamber around the motor until all of the original air has been displaced. The inlet and outlet valves are closed and the mixture inside the motor ignited. Observations are made to determine the volume of flame escaping, and pressures are recorded. A minimum series of 15 to 20 tests is conducted over the flammable range with the motor running in some instances. Turbulence through fan action of the motor tends to bring about explosion pressures roughly proportional to the free volume inside of the motor-enclosing case.

Explosion-proof motors, designed and tested as described, have amply proved their usefulness in many hazardous atmospheres classified as Class I, Group D. These include acetone, alcohols, toluol, benzol, high-test gasoline, lacquer solvents, petroleum distillates, and many other substances.

Such motors are not generally usable in more hazardous mixtures involving acetylene, hydrogen, and ether. In some cases, the ignition temperature of the gas is too low for safe use. In other instances, the possible explosion pressures are too great and may necessitate different mechanical construction.

It is not always proper to assume that explosion-proof Class I, Group D, motors are dust-tight and suited for combustible dust conditions, although most manufacturers use dust-tight construction in explosion-proof designs.

Class I motors may be applicable in many of the preliminary stages of the production of explosives, for example TNT and smokeless powder, since the material then is in wet form and involves a considerable volume of solvent of the Class I, Group D, order. Obviously, where genuine Class I, Group D, hazards exist, explosion-proof Class I, Group D, motors are applicable.

In some instances, the solvent involved is ether, a Class I, Group D, hazard, involving lower ignition temperatures and higher explosion pressures. Except for the fractional-horsepower Class I, Group C, motors so far developed, the Class I, Group D, explosion-proof motors already in production no doubt are the best available for ether atmospheres, although not primarily designed for it. Obviously, no claim is made that they are suited for operation in ether atmospheres. Successful operation in ether will depend to a major degree on careful selection, application, and maintenance of overload relays which will prevent abnormal heating from any conditions of operation.

In subsequent stages of explosives manufacture, where the hazard changes from one of solvent vapors to a condition involving masses of somewhat drier, although not dusty explosive materials, remote location of the motors becomes necessary. This is principally due to the necessity for keeping heat-producing sources away from high explosives which might cause widespread damage if ignited.

Mg by Electrothermic Reduction

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Chem. & Met. INTERPRETATION

Recent research and development by the United States Bureau of Mines of the so-called Doerner process has attracted wide attention in industrial as well as in governmental circles. Originally conceived as part of a program to utilize the abundant magnesite resources of the Pacific Northwest, the present need for expanding the production of magnesium metal gives national significance to this work. The recent Bureau of Mines Report of Investigations 3635, May 1942, which is abstracted in these pages, is an important indication of the direction in which this research is progressing. It will be noted that the experimental work of these investigators has led to the design and preliminary operation of a continuous, small-scale pilot plant employing liquid hydrocarbons for the shock-cooling of the magnesium vapors. Operating data on both the units described in this article would seem to promise considerable reduction in both the costs and the hazards of processes dependent upon gas-cooling methods.—*Editors.*

The Bureau of Mines began a study of the various methods of producing magnesium metal from magnesites in 1936. The first work on this program was undertaken at Pullman, Wash. in cooperation with the State College of Washington. At that time the present need for expansion of the industry had not yet been felt; the study was prompted by the desire to establish a new metallurgical industry in the Northwest for utilizing surplus power from the Bonneville and Grand Coulee hydroelectric projects. When the need for the expansion of the industry in connection with the defense program became apparent, the original program was expanded to include other processes and to investigate the methods of producing magnesium oxide from low-grade magnesites and dolomites.

At the beginning of this work, a study of various magnesium processes indicated that the most promising field for research was electrothermic reduction of magnesium oxide by carbon. The original experimental program was drawn up to study and improve processes of this type.

After extensive small-scale experimental work on the various operations of reduction, shock-cooling and distillation, a continuous process was developed which is described as follows: Magnesite ore is concentrated by flotation to yield a product containing not less than 45 percent MgO and not more than 1.5 percent SiO_2. This is calcined in a rotary kiln to produce a calcine containing not less than 90 percent MgO.

The calcine is mixed in a rod mill with 23 percent low-ash carbon. The mixture is fed automatically into an arc furnace at a controlled rate and reacts to form magnesium vapor and carbon monoxide. These products issue at high velocity through an orifice into the shock-cooling flue, where they encounter an atomized spray of light fuel oil. Evaporation of a large part of the oil cools the furnace gas from 2,000 deg. C. to less than 200 deg. C, almost instantaneously.

The rate at which oil is supplied is so regulated that the unvaporized portion is just sufficient to form a fluid suspension of the metal condensate. This regulation is controlled automatically by the temperature of the cooled products. The solid products consist of magnesium metal, magnesium oxide, carbon, silicides and carbides of the ore impurities intermixed with liquid oil. The vapor phase is composed of oil vapor and carbon monoxide plus some hydrogen and methane resulting from the thermal dissociation of the oil.

The solid condensate and liquid oil are separated as a sludge from the oil vapor and gaseous products in a centrifugal separator of special design. The oil vapor subsequently is condensed in a water-cooled scrubber, and the lighter fractions are recovered in refrigerated coils. The exit gas contains about 50 percent CO, 30 percent hydrogen and 20 percent methane. These have a fuel value about equal to that of the dissociated oil.

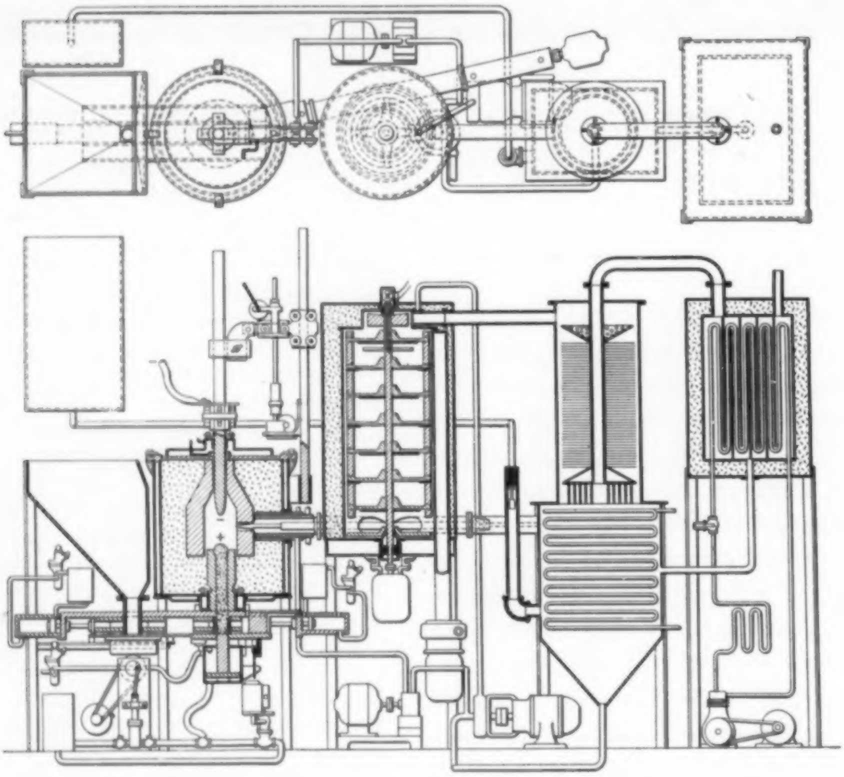
The sludge condensate flows by gravity from the separator and is pumped to the two-stage distillation furnace, in which the oil and magnesium are recovered separately by distillation. The oil thus recovered combined with the oil previously condensed in the scrubber is recirculated through the spray nozzle.

The oil-distillation unit includes a horizontal retort electrically heated to 500 deg. C. The sludge is recovered through this retort in pans attached to a pair of chains. The oil vapors are swept from the retorts to a water-cooled condenser by a current of hydrogen circulated through the gas-tight system. The small amount of hydrogen lost through leakage is replenished by cracking of the oil.

The removal of oil from the sludge leaves small, dry, porous cakes containing about 50 percent magnesium metal. These briquets drop out of the pans into a hopper from which they are fed into cages. The charged cages completely fill a horizontal, alloy-steel retort, heated by electric resistors to 1,000 deg. C. The magnesium metal evaporates from the briquets, and the vapor is carried by a current of hydrogen to a condenser, from which the molten metal is tapped.

Movement of the cages through the retorts and their return to the feed are accomplished by a ram and drag-chain mechanism, both of which operate outside the heated zone. The charging of briquets, discharging of residues, and all movements of the cages are accomplished automatically.

Although continuous and uninterrupted operation of the pilot plant



Plan view and sectional elevation of the magnesium reduction unit assembly

has not yet been realized, the results that have been obtained show that it is practicable to use oil or liquid hydrocarbons as shock-cooling medium. Oil has been found to be as effective as gas for shock-cooling magnesium vapor when atomized in a nozzle of proper design. At the same time it offers many advantages that make the equipment required smaller and less expensive and permits safer and simpler operation.

A satisfactory grade of oil for the purpose is light stove oil. Only 25 lb. of such oil has a cooling effect equal to approximately 1,000 cu.ft. of gas. The total volume of gas and oil vapor per pound of magnesium is about 150 cu.ft. at atmospheric pressure at a temperature of 180 deg. C. For shock-cooling with gas, the total volume of exit gases under the same conditions is more than ten times greater. This difference in volume of the gaseous product represents considerable difference in the size and cost of equipment for handling the gas and separating it from the condensates. Furthermore, since the condensate from the reduction furnace is protected from oxidation by the oil, the hazards and problems with handling a pyrophoric substance are, in large part, eliminated.

The following data represent an average for operation of a unit.

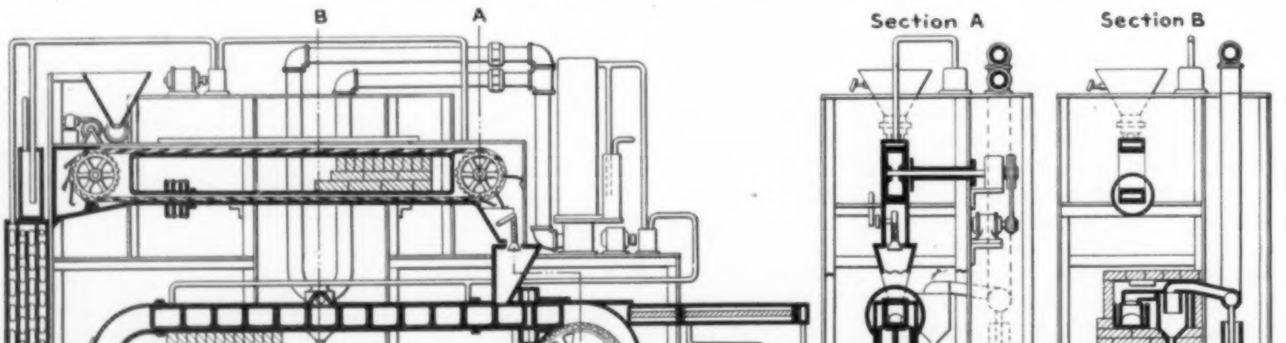
Operation Data for Reduction Unit

Capacity, lb. Mg per hr	7.11
Conversion, percent	76.8
Power consumption, kwh. per lb. Mg	12.3
Oil consumption, lb. per lb. Mg	0.75
Electrode consumption, lb. per lb. Mg	0.18
MgO in condensate, lb. per lb. Mg	0.50
Carbon in condensate, lb. per lb. Mg	0.62
Byproduct gas (CO,H_2,CH_4), cu.ft. per lb. Mg	26.5

Development of the two-stage continuous distillation process has not yet progressed to a point where a full-sized commercial unit could be designed. Operations of this unit had to wait successful operation of the reduction unit so that development has been slower. The distillation operation involves a number of problems of design and heat transfer that become increasingly complex as the capacity of the unit increases, making it necessary to attempt only gradual development of successively larger units. From experience with the small distillation unit, it seems likely that a unit could be developed that would have a capacity of 100 lb. of metal per hr. with an energy input of 150-200 kw. Assuming a radiation loss of 10 percent, it is estimated that this unit would require 0.57 kwh. for the oil distillation and 1.16 kwh. for magnesium distillation, a total of 1.73 kwh. per lb. of metal produced.

Further work is being carried out to investigate a new type of distillation operation, which is expected to permit considerable increase in capacity.

Two-stage continuous distillation unit in which oil and magnesium are recovered separately



Managing New Product Development in Chemical Industry—I

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Chem. & Met. INTERPRETATION

Chemical industry has set an outstanding record in the number and quality of new products introduced within the last few decades. However, little has been written about the techniques used by chemical management in approaching and carrying out these developments. This phase of industrial expansion and competition will take on a new significance when peace finally comes and executives of those concerns that hope to survive and expand must continue their habits of planning well in advance of anticipated events.—*Editors.*

ONE GENERAL approach to new product development is, of course, to appropriate funds, hire scientists and then tell them to go to work to discover something of value to the company. This method has not been very successful because it lacks direction. To secure the best results, research and development must be steered, coordinated, and managed in a way consistent with other activities of the company.

However, new product development is only one phase of the research and development activities in a large chemical concern. Other related objectives include finding new uses for existing products, improving present products and processes, developing new processes, and fundamental research to advance scientific knowledge.

In the following sections new product development is discussed as a series of logical steps from the inception of ideas through the preliminary screening process, the research and development stages to the final transfer to full-scale operations. In each of these steps, both technical and economic factors are considered.

SOURCES OF IDEAS

First step in product development is to find good ideas for new products. At certain times management searches aggressively for a good idea to fulfill a specific need, but at all times it must make provision for a steady influx of ideas. New product suggestions come from many different sources and it is necessary to stimulate and develop these at all times. Sources that have been found important by executives in the chemical industry are listed according to their point of origin.

Research Department—Since research men spend much of their time working on new products it is natural that they furnish many ideas for other new chemicals. Their ideas usually appear in the form of suggested chemical compounds and possible ways of making them. In many companies, this source is stimulated by conferences of entire research and development staffs several times a year to provide an opportunity to compare notes and discuss technical problems. Frequently new chemical compounds are discovered by accident or through "leads" uncovered during the investigation of some other problem, thus turning out to be by-products of other research projects. As one executive put it, "New chemicals often show up as branches on the tree of another research project."

Sales Department—Different companies in the chemical industry have had different experiences with salesmen as originators of ideas. Comments range from "No good ideas for new products come from salesmen" to "Salesmen are an important source of ideas for new chemicals." The value of salesmen for this purpose seems to depend on their technical training, the nature of their work, (whether primarily selling or sales engineering), and whether they are expected to devote some of their time to thinking up ideas for new products, new markets and new uses.

Market development and sales service men who do experimental selling and customer-contacting seem to be very valuable in bringing in new ideas based on their experience with customers' problems and their understanding of chemical technology.

Customers—Many companies are trying to get more and more ideas for new products from their customers. These may be funneled through salesmen and market development men or they may be brought in by the customers themselves if they feel that the chemical concern can actually do something about the suggestion. There is one difference in approach to new products which is illustrated by the ideas from research men and those from the sales department and customers. Suggestions from the former are usually based on specific chemical compounds, and the succeeding development consists of developing a process and finding uses for the product. On the other hand, ideas from customers and salesmen are usually based on industrial needs and desires, and the development consists in finding products to meet these needs. The chemical industry has often been criticized for not using the "customer need" approach more frequently. However, there is evidence that most chemical companies use both approaches and try to strike a balance between the two.

Inventors—Almost all of the executives interviewed agreed that inventors are a poor source of new

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For several years the Department of Business and Engineering Administration at Massachusetts Institute of Technology has been studying the problem of management of new product research and development. The present study, made in partial fulfillment of the requirements for the degree of Master of Science, is one of several to be made in that field. Material for this investigation was gathered in a series of personal interviews with executives in several representative firms in the industry. The author, who is also a graduate in chemical engineering from the University of Washington, will conclude the series next month by discussing management of large scale development, transfer to commercial production and management problems in general.—*Editors.*

product ideas. Nevertheless, provision was made in every company to scrutinize suggestions from inventors in order to avoid overlooking a good opportunity. One executive stated, "Most of the ideas of inventors are old ones in a new form. In addition, most inventors do not understand or realize the capabilities of the company, such as its usual raw materials, methods of manufacture, product lines, etc."

Executives—Ideas for new products may come from executives if their training, experience, and interests lie close to product development activities.

Other Chemical Companies—Ideas are obtained from other chemical companies directly by transfer or sale, or indirectly by making an analysis of competitors' products with the object of finding out what weaknesses or gaps are apparent. Other minor sources of ideas include the technical literature, fellowships in universities, and charts of derivatives of present products.

SCREENING OF IDEAS

Next step in the development process consists of selecting certain of the more promising ideas for intensive research and development. This necessitates the screening process, in which various aspects of each suggestion are considered before it is turned over to the research and development workers. Many proposed projects are rejected in this stage of examination. Usually several executives participate in the screening process, as it is necessary to consider every element that affects the chances of ultimate success of the new product. The chief research executive is usually the most important person in the selection process since he passes judgment on technical aspects.

In some companies there is a separate department, often called the development division, which considers the economic factors. In addition, most companies have research committees composed of executives from each of the major departments of the concern. These either control the selection of research projects or act in an advisory capacity to the chief research executive. Factors usually considered in preliminary screening are outlined in the following paragraphs.

Company Policy—This defines the field of activity and interest of the particular company and indicates which general classes of new products should be considered. Most chemical companies prefer new products that will utilize their own "know-how" and peculiar abilities, that can be sold to the same type of customers as those already served, and that are chemically related to present products.

Chemical Feasibility—This factor is always studied in the early stage by discussions and "paper work" and frequently by conducting a few experiments in the laboratory. One director of research has been authorized to spend without special permission up to $500 for preliminary research on any one idea.

Engineering Feasibility—Ordinarily, engineering questions are not considered in great detail at this stage unless it seems likely that they will later offer difficulties. The availability of suitable materials of construction, design of unusual equipment and containers, and similar engineering problems are investigated in a preliminary way by chemical engineers to make sure that engineering difficulties will not "kill" the project at a later stage.

Hazards of Manufacture and Use—If possible, these elements are studied during the preliminary screening stage. Usually, however, it is not possible to completely evaluate such hazards until quantities of the new product have been made in the laboratory.

Cost of Manufacture—This factor, extremely important to any company, is studied as completely as possible during preliminary screening. Usually only rough guesses can be made, based on raw material costs, theoretical yields, and average allowances for other elements of cost. The purpose of cost estimates at this stage is to avoid undertaking research on entirely impractical ideas.

Cost of Research and Development—Executives agree that it is almost impossible to forecast accurately the cost of developing a new product, but most of them do make preliminary estimates based on their previous experience.

Return on Investment—A preliminary estimate is usually made of the expected return on the investment in research and plant facilities, since this factor is of most interest to the top management. This return is based on estimates of markets, costs, and fixed capital. Like them, it is an approximation which may not be very accurate but which is better than no estimate at all.

Competition—One of the duties of those selecting new product ideas is to consider the status of competitors in the field in which the new product will enter. One executive said that he tried to estimate competitors' costs and to forecast their actions when the new product was released.

Size of Market—It is difficult to estimate in this preliminary stage the quantities of the new product which could be sold, but an attempt is often made to do so. However, practice in the industry seems to vary widely. Some companies wait until research has been completed before estimating the potential market while others make market surveys as the first step in screening ideas. The purpose of preliminary market surveys is to determine if the potential demand is large enough to justify development of the product.

Raw Materials—It was indicated by most executives that raw materials are not studied to any great extent at this stage. It is to be expected, however, that the present material scarcities will make it imperative to investigate this aspect before extensive development is undertaken.

Patents—A patent attorney familiar with the field of the proposed new product usually indicates the general patent situation and the difficulties that might be encountered.

In the screening process the object is to investigate in a preliminary way all factors which must be studied more thoroughly later as well as to locate the strategic factors and to subject them to careful scrutiny. One executive stated, "Perhaps the first steps in new product development may be summarized by stating that the weakest links are sought by high-spot studies and that these are followed to the 'bitter' end. Eventually, of course, all pertinent factors must be studied in considerable detail if the recommendation is made to go ahead. On the other hand, if one of the 'weak links' in the chain proves to be unavoidable and disastrous, many other factors are never studied."

RESEARCH STAGE

The core of this stage is the chemical laboratory research carried out by chemists and physicists to explore ways of making the new product on a laboratory scale. The techniques used by research scientists need no explanation. It is interesting, however, to take a bird's-eye view of the entire technical development process, of which laboratory research is just one part.

Executives were asked whether a new chemical product always went through the five steps of small-scale and large-scale laboratory work, pilot

plant, semi-commercial plant, and finally full-scale plant production. Answers ranged from, "A new product should always go through all of these stages, unless the company wishes to gamble," to "We try as far as possible to eliminate one or more of these steps, since we feel that a smart research organization can use only those steps absolutely necessary for each new product." The characteristics of the particular chemical being studied are undoubtedly the controlling factors, but there is still some leeway to exercise judgment in deciding whether to omit one or more steps. The reason for such an elimination is to save time so that the product can be released to the market at an earlier date. However, some risk is taken inasmuch as difficulties may later be encountered which could have been found and eliminated on smaller scale work.

Before research activities are started, the director of research usually plans the general line of attack so that the experiments are directed toward the proper goals. One type of planning consists of making up a list of specifications to which the final product should conform. In one company this list is called a directive and includes requirements which must be fulfilled, as well as recommendations on certain properties desirable but not absolutely essential. This aids the manager in deciding when a new product should be transferred from the laboratory into the pilot plant.

PROGRESS REPORTS

Control over research activities is exercised in many ways. In most companies, research groups are required to submit progress reports once a month in addition to the quarterly and yearly reports. These indicate to the research director what progress is being made on each project and helps him in directing the activities.

Financial control is usually exercised through appropriations in the company budget for research and development expenses. There is evidence that in many companies these budgeted amounts are very flexible and do not constitute a tight restraint on research activities. While the appropriation may be broken up into assigned amounts for each project, these amounts seem to be milestones by which progress is measured rather than stopping places. In most cases a research project is not terminated when the assigned allocation is spent.

Patent protection for discoveries made in research is procured by staffs of patent attorneys who work closely with the research scientists. Some companies have staffs of patent attorneys which specialize by groups of chemical products so that they can understand better the nature and importance of discoveries made in these fields.

ECONOMIC FACTORS

Along with laboratory research, investigations are usually made of several economic factors, including manufacturing costs, markets, packaging and shipping requirements. In almost every company, estimates of the cost of manufacture are made frequently during the process of research and development, each succeeding estimate becoming more and more accurate. These are sometimes made by the research workers themselves, and sometimes by a development staff which specializes in studying economic factors.

Market studies are often made completely in the preliminary screening stage but sometimes not until the product is in the pilot plant. Most often they are made while the product is in the laboratory. Some companies make complete surveys for each new product, while others estimate markets primarily on the basis of the demand for samples of the new product. In some concerns there are "market research" staffs which specialize in making the surveys, including statistical studies of production and consumption data and field interviews with potential customers. In other companies reliance is placed on the judgment of the executives as to the size of the market.

Packaging and shipping requirements usually require study by research workers, engineers, the sales department, and the transportation department. When standard containers can be used, these problems do not require much attention. However, in other cases, special containers must be designed and constructed.

There is one distinction between synthesizing a new chemical product in the laboratory and evaluating its utility, and this is often made the basis for a separation between the research and the applications laboratories. The latter are concerned primarily with the determination of properties and uses of the new products developed by the research laboratories. An application study is made either simultaneously with the research work or after a substantial portion of research has been completed. The report of the applications laboratory furnishes the executives with a valuable evaluation of the new chemical as developed in the laboratory.

Applications laboratories in many companies are divided into groups dealing with allied products for customer industries. Examples include such divisions as textile chemical laboratories, lacquer laboratories, and rubber chemical laboratories. In some large concerns where there are several operating divisions, an applications laboratory is maintained by each division, while pure research work is centralized in one main laboratory. The applications division also frequently does customer service work.

At times the application study is carried further by testing small samples of the product in customers' plants. Most companies defer such testing until large quantities are available from pilot plant operations, but in some cases tests are made during both research and pilot plant stages. The laboratory product of one company is tested in a limited way in customer plants by a research chemist from the producing company, while the pilot plant product is tested thoroughly in customer plants by special "contact" men. Large scale development and testing of new products in customer plants will be discussed fully in a later issue.

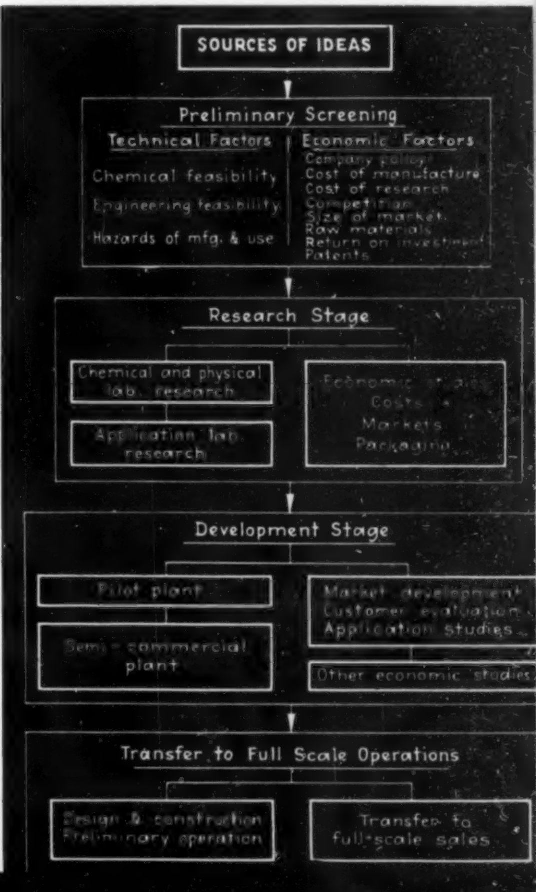

Diagram showing the normal phases of new product development in chemical industry. Technical and economic factors are investigated simultaneously

Special Slide Rules Can Facilitate Many Engineering Calculations

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Chem. & Met. INTERPRETATION

Special single-purpose slide rules designed to solve chemical engineering equations are valuable when repetitive computations must be made, especially by mathematically unskilled persons. Design and construction of such rules is not difficult. The author describes three types of equations which can be set up on rules, showing in detail how each type is handled. Although mentioning that suitable blanks for special rules can be purchased, he shows how blanks can easily be constructed from cardboard, wood or other materials.—*Editors.*

Ordinary slide rules have long been important mathematical tools of the chemical engineer. Special rules, limited in their application to the solution of a single equation, have been utilized to considerable advantage in other fields of engineering for some time, articles on their construction having appeared in the literature as early as 1904. It is rather surprising, therefore, that their use has not been more extensive in chemical engineering, especially since the equations used in heat transfer and fluid flow are quite well adapted to such rules.

Nomographs are frequently encountered in chemical engineering work. Since a special slide rule is merely a modified type of nomograph, much of the material now used in nomographic form could be handled on slide rules with equal or better accuracy and a considerable increase in handling convenience. Slide rules are superior to nomograms in being more portable and less subject to error in reading, while they require no auxiliary equipment.

The type of slide rule described in this paper is not intended for manufacture and sale, but for construction and use within an individual plant or office. Where fairly complicated computations must be repeated frequently, or where computation must be placed in the hands of mathematically unskilled persons, special slide rules offer an almost ideal method of solution. An excellent example of the simplicity of operation achieved by using a special slide rule is shown in Fig. 2. This computation ordinarily requires the use of a log slide rule and, when Reynold's number exceeds 20,000, the use of logarithms. On the special slide rule shown, all powers are automatically taken into account and only values of the variable need be set. No conversion factors are required and the actual values of the inside pipe diameters need not be sought in a table.

SLIDE RULE PRINCIPLES

Principles underlying the construction of slide rules of all types have been known for some time and are discussed in several well written articles and texts. These works were, however, not written by or for chemical engineers and seem largely to have escaped the notice of most students in this field. In general, methods and terminology used in this article are essentially those of Hoelscher, Arnold and Pierce[3], although material has been used from other sources.

The basic principle involved in the construction of slide rules is the addition of lengths proportional to the values of functions; the addition of the lengths being equivalent to the addition of the functions themselves. This principle is fully discussed in several of the references[3,5] and needs no discussion here. When the functions used are logarithmic, addition of the functions is equivalent to multiplication of the variables.

Major problems involved in laying out special slide rules are to find (1) the type of rule necessary, (2) the direction in which the scales must run and (3) the method of properly subdividing the scales.

Type of Rule—Many types of combinations of fixed and sliding scales are possible, but three fundamental types are satisfactory for most problems: (1) the single slide, (2) the double slide and (3) the middle support. These three types are illustrated in Figs. 1, 2 and 3, and 4 respectively. Each type is suitable for different types of equations.

Let $f(x)$ be defined as an expression containing only the variable x; for example x, $\frac{1}{4}\log x$,

$$\frac{e^x\text{-}\log x + \cos^3 x}{\tanh 3/x},$$

$x^{2.13}$, etc. This is the customary algebraic definition of $f(x)$.

Using this definition of $f(x)$, the following types of equations may be solved by rules of the three types previously mentioned as shown below:

Form of Rule	Type of Equation	
Single Slide	$f(x) + f(y) + f(z) + f(\theta) = 0$	(1)
Double Slide	$f(x) + f(y) + f(z) + f(\theta) + f(p) + f(q) = 0$	(2)
Middle Support	$f(x) + f(y) + f(z) = f(k)$	(3a)
	$f(\theta) + f(p) + f(q) = f'(k)$	(3b)

Examples of each type of rule are given in this paper showing a typical problem solved by each rule. Any one term in the above equations may be replaced by zero, in which case an index point replaces a scale. The addition of a constant term does not affect the status of the equation. The use of an index

point is illustrated in Fig. 4. Considerable ingenuity is sometimes necessary to get given equations into one of the foregoing type forms (1), (2) or (3).

Direction of Scales—When the type of rule required has been determined, the direction in which the values of the function will increase (i.e., whether values increase to the right or the left) must be determined. This is a comparatively simple matter if the following rules are observed:

1. Write the equation with all terms to the left of the equals sign.
2. Write the terms of the equation in the order in which they are to appear on the slide rule in a vertical row, reading from top to bottom of the rule.
3. Prefix alternate plus and minus signs to the right and left of the functions listed.
4. Draw arrows in the direction of the sign prefixing the term, as written under Rule (1).

The arrow indicates the direction of increasing values of the function. It should be noted that the order of increasing values of the variable may be reversed from the order of increasing values of the function (e.g., when $f(x) = 1/x$). Examples of the application of these principles are shown below under the individual equations for which slide rules are illustrated.

Length of Scales—The length of scales is determined by the range of values of the variables used in constructing the scales. Since lengths of the scales are proportional to the values of the functions, the range of values is multiplied by a number m, called the functional modulus, to obtain the scale length. This functional modulus must be the same for all scales on the rule, and its value is determined by the function which has the greatest proportional range of values. Stated mathematically:

$$L_s = m\,[F(x) - \phi(x)] \qquad (4)$$

where L_s = length of scale for $f(x)$, in inches; m = functional modulus, inches of length per unit of the function; $F(x)$ = largest value of $f(x)$; and $\phi(x)$ = smallest value of $f(x)$.

LAYING OUT SCALES

In laying out logarithmic scales, it is convenient to have at hand a series of logarithmic cycles of various lengths. These may be constructed as shown by Davis and Genereaux[7], or by means of an ordinary slide rule and proportional dividers if these are available. A chart as prepared by Arnold[1] is exceptionally convenient for this purpose.

The above principles of construction were utilized in the construction of the rules illustrated in Figs. 1 to 4. None of the rules illustrated requires a slider. The operation in each case is to match a variable with a variable until the final answer is read opposite the last variable employed. As an example, in Fig. 2, one problem solved when the rule is set as shown is: $k = 0.14$, $D = 1.5$, $\mu = 25$, $c = 1.5$, Re $= 10{,}000$, giving $h = 500$.

The means of constructing the slide rules illustrated herein are discussed below in some detail in order to afford greater clarity to the method outlined above.

Example I—Rule with single slide (Fig. 1). McAdams[6] gives the equation $h = (154 + 1.6t)\,V^{0.8}D^{-0.2}$ for finding the film coefficient of heat transfer for water flowing in turbulent flow inside horizontal pipes. Here h = coefficient of heat transfer, B.t.u. per hr., sq. ft. and deg. F.; V = velocity, ft. per sec., based on a density of 62.3 lb. per cu. ft.; D = inside diameter of pipe, inches; and t = temperature of water, degrees F. If we arrange this equation in logarithmic form, we obtain the following:

$$\log h + 0.2 \log D - \log (154 + 1.6t) - 0.8 \log V = 0 \qquad (5)$$

This equation is of the form given in Equation (1), so it may be represented by a single slide rule.

Let us suppose that we wish to use the rule for problems involving the following limits: $6 < D < 1$ in., $200 < t < 40$ deg. F., $5 < V < 0.5$ ft. per sec., and $1{,}000 < h < 100$ B.t.u. per hr., sq. ft. and deg. F.

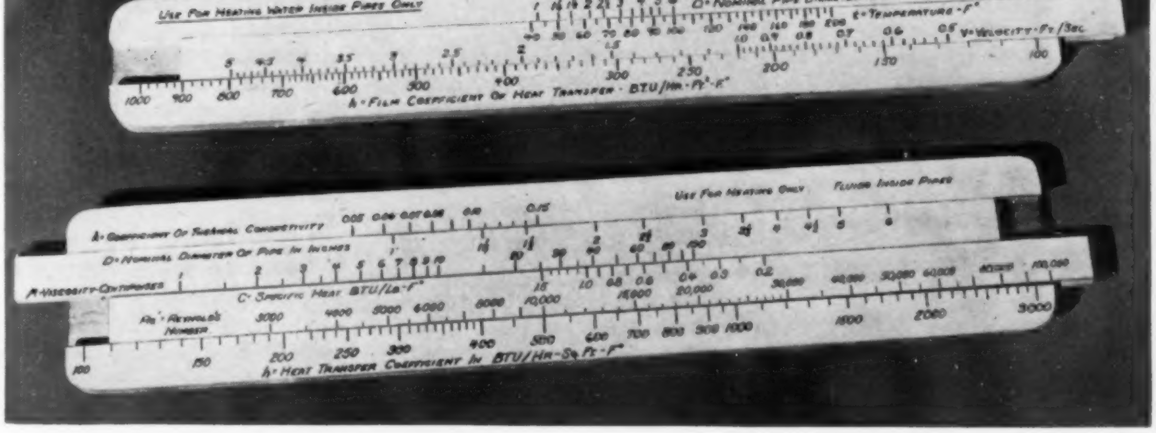
Applying Equation (4) to each of the variables in turn, we obtain: $L_h = m(\log 1{,}000 - \log 100) = m = 13.0$ in.; $L_D = m(0.2 \log 6.025 - 0.2 \log 1.049) = 0.152\,m = 2.0$ in.; $L_V = m(0.8 \log 5 - 0.8 \log 0.5) = 0.8\,m = 10.4$ in.; and $L_t = m[\log(154 + 1.6 \times 200) - \log(154 + 1.6 \times 40)] = 0.377m = 4.4$ in.

If a blank slide rule 14 in. long is to be used and we wish to allow the longest scale to run 13 in., we may by inspection evaluate $m = 13$, since the longest scale, from the above equations is m in. long. This value of m gives the scale lengths given on the right of the above equations.

To obtain the direction of the

Fig. 1—Single-slide rule for solution of water heating problems

Fig. 2—Double-slide rule solves Dittus-Boelter equation for liquid heating



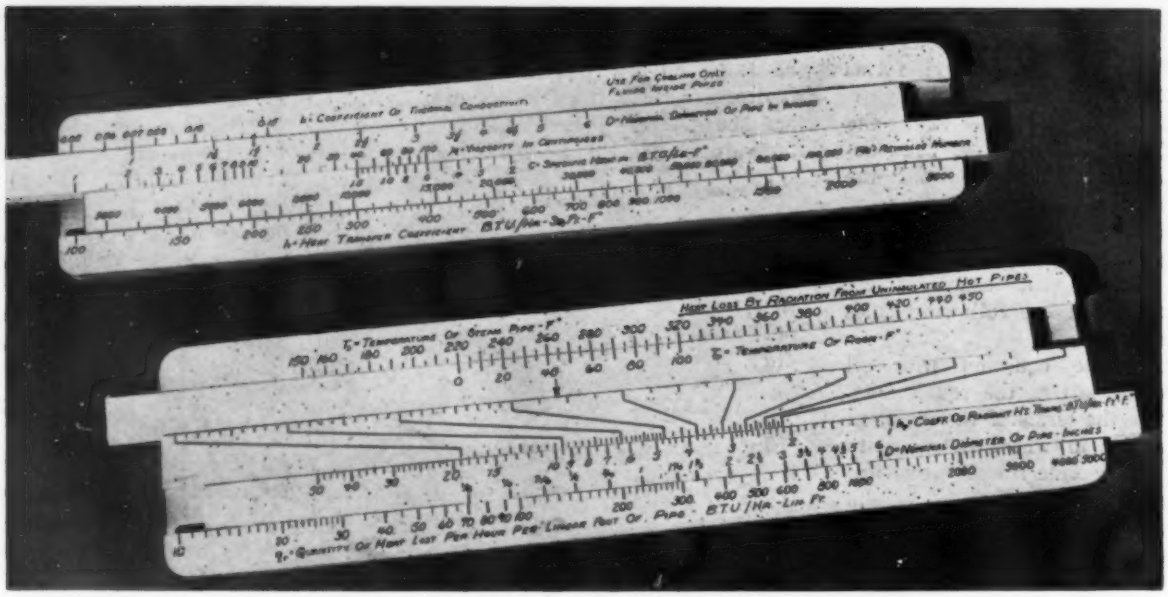


Fig. 3—Double-slide rule similar to Fig. 2, for liquid cooling problems

Fig. 4—Center-support double-slide rule for radiation losses from pipes

scales, we apply to Equation (5) the rules given earlier, and obtain:

$$
\begin{array}{llll}
(a) & -\ D + \rightarrow & \text{or } (b) & \leftarrow +\ D\ - \\
 & +\ t\ - \rightarrow & & \leftarrow -\ t\ + \\
 & \leftarrow -\ V\ + & & +\ V\ - \rightarrow \\
 & \leftarrow +\ h\ - & & -\ h\ + \rightarrow
\end{array}
$$

Using Set (a), then, scales for V and h must increase to the left, those of D and t to the right.

The scales for h and t may now be graduated by using a logarithmic cycle 13 in. long. Values of $(154 + 1.6\ t)$ should be laid out, since $f(t) = 154 + 1.6\ t$, but each graduation should be marked with the corresponding value of t, not $154 + 1.6\ t$, this makes the rule direct reading. Values of D may be measured with a log cycle $0.2 \times 13 = 2.6$ in. long. If values plotted are those of actual inside diameter of the pipe as determined from tables, but the values are labeled as the nominal diameter of the pipe, the rule will be direct reading for standard pipe sizes. The V scale is laid out using a logarithmic cycle $0.8 \times 13 = 10.4$ in. long.

One set of values must now be substituted into the original equation and a solution obtained. After the scales are graduated, they are glued to the slide rule blank in such a manner that the values substituted above are satisfied throughout. The rule will then satisfactorily solve all problems within its range.

Example II—Rule with double slide (Fig. 2). This rule solves the Dittus-Boelter equation for finding the film coefficient of heat transfer for liquids being heated inside horizontal pipes. This indicates the use of the double slide rule. The equation involved is $hD/k = 0.0225\ (\text{Re})^{0.8}\ (c\mu/k)^{0.4}$ where h = film coefficient of heat transfer, B.t.u. per hr., sq. ft. and deg. F.; D = inside diameter of pipe, ft.; k = thermal conductivity, B.t.u. per hr., sq. ft. and deg. F. per ft.; μ = viscosity in English units (centipoises $\times$ 2.42); c = specific heat, B.t.u. per lb. and deg. F.; and Re = Reynolds number, dimensionless.

To adapt this equation to slide rule use, it is modified as completely as possible to $1 = (0.0225\ \text{Re}^{0.8} c^{0.4} \mu^{0.4} k^{0.6})/hD$ which, written in logarithmic form becomes:

$$
\log 0.0225 + 0.6 \log k - \log D + 0.4 \log \mu + 0.4 \log c + 0.8 \log \text{Re} - \log h = 0 \qquad (6)
$$

This last equation is in the form of Equation (2), so a double slide rule is indicated.

Limits chosen for the variables are: $0.15 > k > 0.05$, $242 > \mu > 2.42$, $100{,}000 > \text{Re} > 3{,}000$, $0.5055 > D > 0.0874$ (Std. pipe sizes), $1.5 > c > 0.2$ and $3{,}000 > h > 100$.

Using a functional modulus of 9, obtained by the inspection method shown in Example I, L_k = 2.6 in., L_D = 6.9 in., $L\mu$ = 7.2 in., L_c = 3.2 in., L_{Re} = 11.0 in. and L_h = 13.3 in.

Scales for k, D, μ, Re and h increase to the right, that for c increases to the left.

By calculating values of μ in terms of centipoises, the scale for μ was graduated to read directly in centipoises by a method analogous to that employed in laying out the D scale in Example I. The D scale in this case was graduated to read directly in inches nominal diameter, although laid out as feet actual diameter by a similar method.

The scales were located on the rule with reference to one another by calculating out one specific case as was done in the previous example.

The rule shown in Fig. 3 differs from the one of Fig. 2 only in the exponent of the Pradtl number in the equation on which it is based. In the case of Fig. 3, this exponent is 0.3.

Example III—Rule with middle support (Fig. 4). This rule illustrates the use of an index line and uniform scales. The purpose of the middle fixed scale is to accomplish a transfer of the value of the function which it represents from one side of the rule to the other. Thus it is, in effect, two related single slide rules on a fixed base. The middle-support rule can solve two equations simultaneously, or may be used to solve a single equation of more variables than can be handled conveniently on other types by the introduction of an auxiliary variable. Introduction of an auxiliary variable is used in this illustration. The scale for this auxiliary variable is always graduated, but is not usually calibrated.

The equation $q_r = h_r A\ (T_s - T_r)$ is solved by the rule illustrated in Fig. 4, where q_r = heat lost, B.t.u. per hr. and linear ft. of pipe; h_r = coefficient of radiant heat transfer, B.t.u. per hr., sq. ft. and deg. F.; A = external area, sq. ft. per ft. length of pipe; T_s = surface tem-

perature of pipe, deg. F.; and T_r = temperature of the room, deg. F. The auxiliary variable k is introduced to make the equation suitable for slide rule use and the equation then becomes $q_r/h_rA = T_s - T_r = k$. Or,

$$\log q_r - \log h_r - \log A = \log k \qquad (7a)$$
$$T_s - T_r = k \qquad (7b)$$

Equations (7*a*) and (7*b*) are of the form of Equation (3), which shows that the original equation can be represented by a middle support rule.

Considering (7*a*) and (7*b*) separately, individual single slide rules are now plotted on the lower and upper portion of the rule. The scales for k on both the lower and upper parts of the rule should be made to increase in the same direction.

The same functional moduli need not be used on both the upper and lower halves of the rule. As shown, a modulus of 1/30 is used for the upper half of the rule and a modulus of 5 for the lower half. The index point is located by means of a calculation so that it reads correct values on the upper k scale when set on values of T_s and T_r.

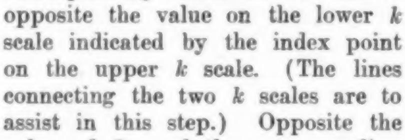
Lines are now drawn connecting equal values of k on the upper and lower k scales.

The operation of the rule is as follows: Set values of T_r opposite the corresponding values of T_s. Set h_r opposite the value on the lower k scale indicated by the index point on the upper k scale. (The lines connecting the two k scales are to assist in this step.) Opposite the value of D read the corresponding value of q_r. In the rule shown in Fig. 4, the variable A does not appear but, since it is a function of D, the value of D is used, thus eliminating the necessity of calculating A for any given D.

The above examples serve to show the general applicability of special slide rules to chemical engineering problems. The method of construction is simple and direct. Any points in the above discussion that are not immediately clear may be most readily cleared up by performing the operations necessary to construct a simple rule. More elaborate treatment of some of the minor points may be obtained in some of the treatises on the subject[1,3]. A little practice should enable anyone with engineering training to construct rules for many of the more common formulas whose solutions are repeatedly required. The author has found the rules illustrated very convenient in rapidly checking the work of students, and in certain simple design problems. Such a rule need be used only a few times to repay fully the small amount of labor necessary to construct it. In times such as the present when calculations must frequently be put in the hands of young or unskilled workers, the freedom from error accompanying the use of these simple rules in such problems as acid mixing should prove most definitely their value.

Prepared slide rule blanks on which to paste the scales laid out according to the above directions are available[8], but suitable blanks may be made from cardboard, hard rubber or other material at hand. Cardboard, sheet resin or wood work out well when glued as shown in Fig. 5.

Fig. 5—Cross section suggesting method of rule construction



The author wishes to express his gratitude to Professors J. N. Arnold and C. L. Lovell of Purdue University for their interest and suggestions during the preparation of this manuscript.

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CHRONIC POISONING

(*Continued from page* 81)

We have, therefore, in regard to chronic poisoning hazards the following difficulties:

(1) Hazards are difficult to detect except by chemical or physical means.
(2) Effects of the poisoning are spread out over a long period of time and the results not noticed until the condition is far advanced.
(3) There is a very great difference in susceptibility, so that experience with an exposure over a long period of time is no indication that a new man might not die after a very short exposure to the same material.

The control of hazards of this chronic type can generally be accomplished in the following manner:

(1) Existence and seriousness of the hazard can be determined by chemical or physical tests. When the amount of a given material in the air and the number of hours per day that men are exposed to this material are known, it is then possible to state whether or not the danger of chronic poisoning exists.
(2) Next step is the substitution whenever possible of a non-hazardous material for the poisonous one.
(3) Exposure should be limited to as few operators as possible.
(4) Operations should be isolated as far as possible to protect employees not actually working on the job.
(5) Exposure can be minimized by rotating employees on the hazardous job.
(6) Men can be protected by use of ventilation and personal safety equipment, such as respirators and gas masks.

In regard to ventilation, it is important to prevent the fumes or dusts from ever getting into the air. One way toward accomplishing this is to ventilate by means of local exhaust hoods which remove the harmful material at the point of generation. This is much more economical than attempting to ventilate large working areas.

EXPERT ADVICE

When problems of chronic poisoning arise, it is very desirable to contact authorities who have knowledge regarding these hazards. The State Department of Industrial Hygiene, or in some states the State Labor Department, the National Safety Council or representatives of insurance companies all have considerable information regarding toxic limits and the control of toxic hazards. These agencies are always glad to cooperate in any way toward furnishing information or making studies. Such information and services are available without charge to practically any industrial plant.

It is hoped that this introductory article points out in a general way the problems encountered in industrial poisoning and hazards. Special problems of various chemicals or processes will be discussed in future installments to appear in this magazine during the next three months.

Operating Variables Charted by Electrical Recorders

REGINALD TRAUTSCHOLD *Consulting Engineer, Passaic, N. J.*

Chem. & Met. INTERPRETATION

Records of current load or voltage on electrical equipment serving process applications often supply reliable information on the progress of an operation or reaction, on down time or faulty functioning of equipment which cannot be recorded as simply or conveniently by other means. The author has studied several such applications for standard electrical recorders and has found that excellent, money saving results can be achieved in this simple fashion, for example, in the case of evaporators, crystallizers, sintering machines and conveyors.—*Editors.*

MEASURING operating variables electrically is in many instances a most effective and decidedly inexpensive way of ascertaining critical controlling conditions, in industrial manufacturing and processing undertakings. A few quite typical cases will serve to demonstrate this fact—just how important a role standard recording ammeters and voltmeters play nowadays in keeping down operating expenses and in supplying that indispensable guidance essential for close operating control in commercial production activities.

Sugar—At The Amalgamated Sugar Co. refinery, Nyssa, Oregon, standard Bristol recording ammeters are inserted in the circuits of the motors driving crystallizers and the instrument postings supply the information needed in controlling the saturation of the fillmass. The fillmass in the crystallizers cools and becomes more highly saturated as the process advances, causing the load on the motor to rise and the amperage consumption to increase. Consequently, the graphs traced by the recording instruments, of which Fig. 1 is an example, give irrefutable evidence of the working quality of the fillmass and when the process should be stopped. The measure is, quite obviously, one of attainment rather than of the influencing conditions—temperatures, machine speed and charge proportions—that govern the operation of the crystallizer, so the single measure supplies the quality gage by which the best influencing conditions are empirically established.

Pyrites—A somewhat similar recording ammeter application at the plant of The Pyrites Co., Inc., Wilmington, Del., serves the exhauster motor of a sintering machine and proves a highly effective and dependable detector of operating defects. The graph charted by the instrument placed in the fan motor circuit (Figs. 2*a* and 2*b*) provides a continuous record of the load on the exhauster and of the condition of the sintering bed—furnishing conclusive proof of the efficiency with which the sintering process of ore reduction is consummated.

DETECTING TROUBLE

The general characteristics of these load graphs, their form, likewise bring to light machine difficulties and defects that impose waste burdens and unduly elevate operating expenses. In the chart of Fig. 2*a* the load graph, while fairly symmetrical concentrically (and hence indicative of uniformity in average, or mean, power demand) is decidedly "sawtoothed" in outline. Pronounced peaks and valleys appear at substantially regular intervals. These variances in current requirements are evidences of machine defects, which in this particular case were found to be occasioned by bad grate bars and wearing strips. A correction of these faults was made and the load graph at once took the form shown on the second of the charts, Fig. 2*b*.

All fluctuations in power consumption were not eliminated, it is true, but the swing was reduced from one of substantially 10 per cent plus or minus to one of not more than a fifth as much, plus or minus. This 80 per cent improvement brings about in effect a like or even greater reduction in the wear and tear on the drive motor. Commenting on this gain, The Pyrites Co. stated: "Anything that gives us more uniform operation increases the net return for the same fixed expenditure."

Pulp—Quite a number of similar standard recording ammeters are employed by one of the large pulp and paper mills where they are used for recording the load on disk evaporator motors. In the words of the chief chemist of this organization: "By recording the load on these motors we have a good indication of the strength of the liquor in the evaporators as well as a good record of the mechanical condition of the evaporators. We find that this record is very helpful to the operators as well as a good protection for the motors."

Flour—Greater uniformity of product with less operating expense is also reported by the Western Milling Co. of Pendleton, Oregon. A recording ammeter maintains a continuous graph of the load carried by the 60-hp. motor on the head of the establishment's milling unit. This posted record serves as the guide by which the operators keep their mill adjustments at uniform extraction settings. Necessary control of the flour's moisture content is also reliably indicated by the postings of the recorder, for as the moisture content rises so also does the power consumption.

Coal Washing—At the washery of the Raymond City Coal & Transportation Corp., Cincinnati, the load on a flight conveyor drive is measured and posted by a recording ammeter, which provides a definite check on the washer service, including the

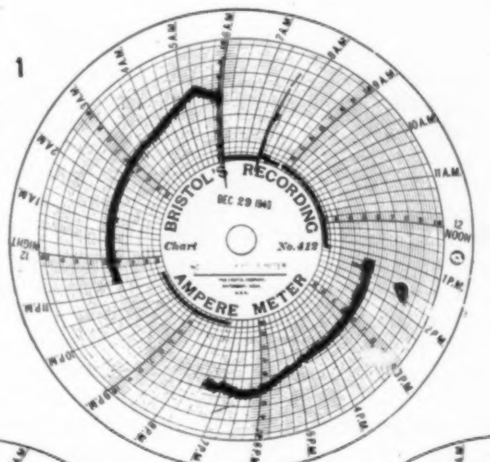
duration of and accurate timing of washer operation. The charted graphs show the amounts of lost time and, consequently, have been responsible for corrections in details of plant operation. The charts have also accurately established the various capacities of the plant.

A chart of this recorder is, in fact, quite an illuminating record. Not only is the load on the washer's conveyor posted continuously, posted as and exactly when it occurs, but when both the conveyor and washer are in service the graph traced is recorded on the outer ring as a heavy inked line, as in Fig. 4. When the conveyor is running but not the washer, the graph traced on the inner ring is heavily inked. A fine inked line is an indication that the plant is shut down.

Mine Conveyors—Recording voltmeters, rather than ammeters, are employed in the mines of other coal companies primarily to post mine delays and incidentally to record mine voltage. The instrument is connected in the feed line to a centrally located, underground, loading conveyor over which all the mined coal passes. When the conveyor is not in service there is, naturally, no voltage to record, but each time the conveyor is put in use the fact is recorded on the instrument chart by a sharply radiating load line. Owing to the necessarily frequent and sudden starts and stops of the conveyor, as well as to variances in load, a veritable sunburst of rays traced by the swing of the recording pen is formed, breaks in which, as indicated by the directional arrows shown about the circumference of the typical chart illustrated in Fig. 5, are signs of mine delays, which are often marked in key colors to register the cause or reason for the interruptions.

Thus, by the exercise of a little ingenuity and wise planning much can be accomplished through the use of electrical recorders, with substantial savings realized and time conserved.

1



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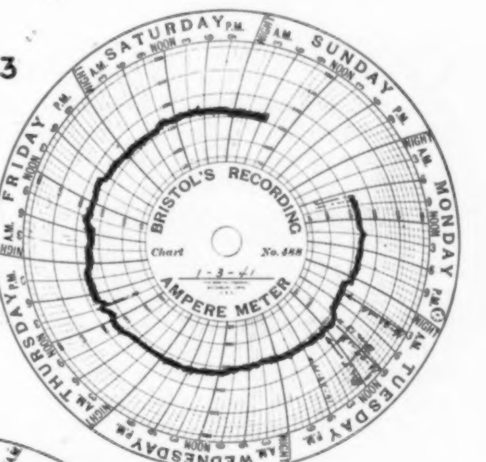
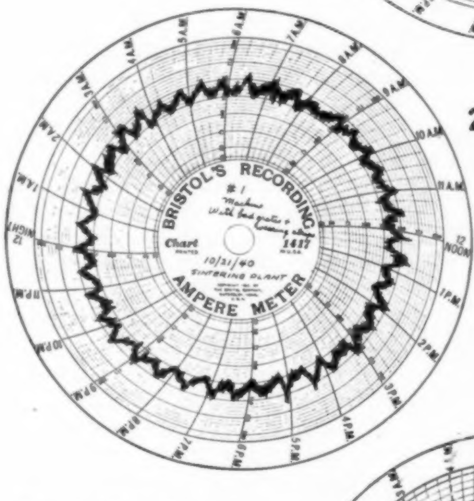
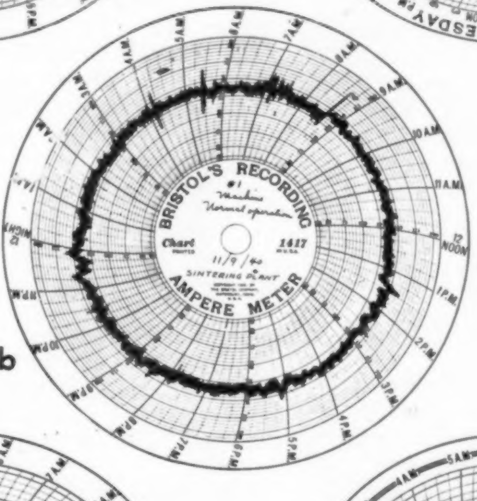


Fig. 1—Sugar crystallizer load record shows progress of crystallization

Fig. 3—Ammeter records assist this mill to secure a uniform product at lower cost



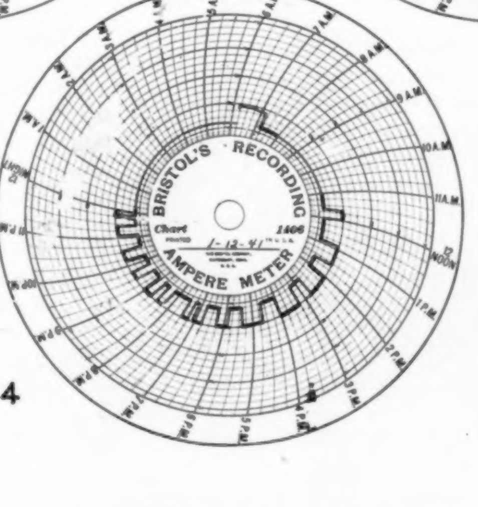
2a



2b

Fig. 2a—Fluctuations in sintering plant load were traced to faulty equipment

Fig. 2b—After repairs sintering plant load became much more uniform



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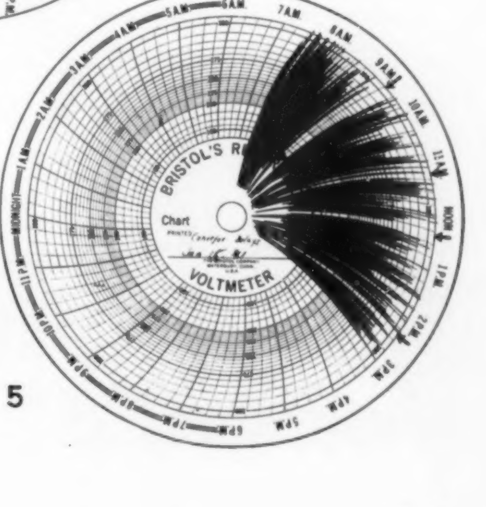

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Fig. 4—Recording ammeter serves as automatic time keeper at coal washery

Fig. 5—Voltage fluctuations show mine conveyor delays; note arrows identifying delay causes

Charts courtesy The Bristol Co.

A Plan for Industrial Good Housekeeping

FELIX N. WILLIAMS
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Chem. & Met. INTERPRETATION

Inter-plant good-housekeeping competition is the Monsanto Co.'s method of promoting cleanliness in its numerous plants. An annual award is made to two having the best records. Improvement of cleanliness and orderliness is a means, not an end in itself. Improved safety records, employee morale and increased production are the result of such campaigns. The scheme outlined here might even be applied on an inter-departmental basis in small plants.—*Editors.*

GOOD HOUSEKEEPING in an industrial plant need not be justified as an end in itself. It is, on the other hand, a practical means to higher production, lower accident rates and improved employee attitude. These facts are of particular significance now when management is under tremendous pressure for increased production and the need for good housekeeping is apt to be overlooked in the press of more urgent problems. Neglect of this problem now would work toward the defeat of the ends being pursued so strenuously.

For a number of years Monsanto Chemical Co. has had in effect a plan to encourage good housekeeping by stimulating competition among the Company's domestic plants. The competition is on a year round basis but ratings are obtained by annual inspection visits. The plants are classified into two groups according to size in order to equalize conditions among them and to avoid placing a plant employing 1,000 men in direct competition with one employing 150 men.

Last year the Monsanto pennant for good housekeeping was awarded to the Shawinigan plant. After presentation, it was raised by two veteran employees

The annual inspection is carried out by two boards, one for each plant group. Each board consists of a general staff executive as chairman, at least one plant operating man of plant manager or assistant plant manager rank and at least one man from a divisional personnel, engineering or research department. At least one man on each committee is drawn from the board of the previous year. The inspection visits are made at a time not announced previously and the order in which they are to visit the plants is not revealed.

The inspections carried out by the committees are detailed and thorough. Every department and every building in every plant is seen and examined by the entire committee. Six points are scored:

1. Good housekeeping which deals with cleanliness, neatness and orderliness of buildings, laboratories, first-aid or medical rooms, and grounds.
2. Sanitation and personnel services including locker facilities, eating and drinking water facilities, toilet and washing facilities.
3. Maintenance of buildings.
4. Maintenance of equipment.
5. Control of obnoxious or tedious working conditions.
6. Personnel, with particular reference to appearance and amount and conditions of uniform clothing.

Each committee member is supplied with a sheet on which he records his detailed scores. Each of six general heads is weighted, 200 points to good housekeeping, 120 to sanitation and personnel services, 120 to maintenance of buildings, 320 to maintenance of equipment, 100 to control of working conditions and 140 to personnel, making a maximum score of 1,000 for each plant. Each of these general headings is broken down into a number of subheads which are assigned weights in accordance with their importance.

The scoring is based on those factors which are controllable by local management and on the condition and use of available equipment. Also taken into consideration is the nature of the products produced or handled, since it is easier to keep a pharmaceuticals plant clean, for instance, than making lampblack.

The committee members make out their score sheets and turn them in to the committee secretary immediately after each plant visit. These are neither revealed nor discussed by the committee as a whole until the final general review. One committee member does not know how the other members scored each plant nor does he know the relative ratings of the plants until the tour is completed. At the end of the trip a general review is held by each committee and the score of each plant is averaged to give a plant score. From these scores the winning plant in each group is chosen.

A number of steps are taken to give recognition to the winning plant. Feature stories are carried in the employee house organ, and mention is made in the general house magazine. A star pennant is awarded each winning plant and flown from its staff. Each employee of a winning plant receives a worthwhile souvenir for his accomplishment such as a wallet and key set or inscribed pen and pencil. These are presented at general employee meetings at which the presentations are made by a ranking executive officer.

The work of the inspection committee does not end with the choosing of the winning plant. A detailed and comprehensive report is turned in to the executive committee of the company giving specific reasons for all point deductions. These reports take the form of criticisms, recommendations for local management and general recommendations. The reports are forwarded to local management and form a plan for improvement. The following year the report serves as a basis for comparison for the next inspection committee.

The plan has been definitely successful in raising the level of good housekeeping throughout the Monsanto Co.'s plants. Every year brings consistent improvement.

CHEM & MET REPORT ON

Fire Protection Methods For Process Plants

TO EXECUTIVES AND ENGINEERS IN PROCESS INDUSTRY PLANTS

Now that the war materials plants of the United States are largely built, and it is raw materials and shipping facilities that are becoming the bottlenecks, conservation of production facilities and the raw materials stored and ready for use emerges as a matter of vital necessity. If the hazards of enemy action still seem remote within the continental borders of the country, nevertheless, there is a much older and more subtle enemy — fire — which is never remote. Times of stress only increase its avidity and redoubled vigilance is required as the price of fire-safety. On this account, *Chem & Met* takes this opportunity to remind its readers of the ever-present hazard, not so much from bombs and saboteurs, as from normal fire causes, accelerated by the pace of the times. In the report which follows we attempt to high-spot the best in protection methods, to outline procedure in organizing and training a plant fire brigade, and to show interested engineers where further information can be had.

Fire Protection Methods For Process Plants

SUMMARY AND CONCLUSIONS

So much has been published in recent months on the special fire hazards of war-time that it seems possible that the ordinary peace-time fire hazards of the chemical process industries may not be receiving quite the attention that they deserve. On that account this report has been prepared, both to discuss the normal hazards, and to show how fires may be fought. In addition, the report goes briefly into the organization and training of the plant fire brigade, and into sources of information on industrial fire hazards, fire prevention and protection.

Several agencies, notably the National Fire Protection Association and the Factory Mutual Fire Insurance Cos. Inspection Department, have cooperated with the editors in supplying the most recently available information. Other agencies also, as noted herein, are available for advice and assistance to the end that industrial fire losses be minimized in these critical days when every pound of production is vitally needed, and every building and piece of equipment lost may be difficult if not impossible to replace.

Fire prevention, the goal of all who are concerned with the avoidance of losses of life and property through fires, can rarely be completely achieved in industry, no matter how closely it may be approached through exercise of eternal vigilance, and the use of every possible precaution. Engineers in every process industry are thoroughly familiar with numerous fire prevention methods applying to their ordinary as well as their special hazards. Many thousands of dollars are spent annually on fire prevention. Nevertheless, fires still occur and will doubtless continue to occur, so long as human failure and improper functioning of mechanical contrivances are possible. Fire prevention alone is not enough. With the best in prevention must go the best in protection. To the latter aim this report is dedicated.

A fact of great importance in considering the fire hazards of chemical process industries is that, more frequently than not, fire arises in most of these industries from ordinary rather than from special hazards, since the latter are more feared, and therefore more carefully guarded against. Partly for this reason but also because special hazard fires in the majority of cases will respond satisfactorily to the same procedures if they are properly chosen and used, the principal emphasis of what follows will be given to the ordinary extinguishment methods which are in best repute today.

Unfortunately, space is lacking for an adequate discussion of the hazards peculiar to the various industries of the process group. Considerable information can be found in the literature, although much of it has been written from the standpoint of the insurance inspector rather than that of the chemical engineer or industrialist. (See Table II on information sources.) In lieu of such a detailed discussion, Table I is presented, which is a condensation of a much more extensive tabulation prepared by the Factory Mutual Inspection Dept. Somewhat similar tabulations (one in the same, and one in much greater detail on fewer materials) can be found in the Crosby-Fiske-Forster Handbook of Fire Protection (see Table II).

EXTINGUISHMENT MATERIALS

Only a relatively few materials are used for fire extinguishment, but there are many ways of applying them. Water is by far the most important agent, and is said to be effective in 85 percent of all fires. It may be used alone, either as a solid stream or as a coarse or a fine spray, all of which have different fire extinguishing properties. It may be mixed with foaming ingredients to produce a fire-smothering blanket, or it may have chemicals added to produce a stream-expelling reaction, to yield enhanced extinguishing properties, or to prevent freezing in cold weather. As a solid stream or coarse spray it is effective on fires in ordinary combustibles where the cooling and quenching effects are chiefly required. As a fine spray it is effective on electrical fires (since in this form it is non-conducting), and on some flammable liquids with which it is immiscible.

In addition to water, the other extinguishing media used in any considerable quantity include carbon dioxide, carbon tetrachloride and a dry powder based largely on sodium bicarbonate. Steam is occasionally used, and magnesium fire hazards have recently made a place for new extinguishing solids including a proprietary power based on graphite, a special granular pitch, and granular feldspar. To some extent a number of the older solid extinguishing materials are still used, including sand, soda, salt, sawdust and talc.

HAND EXTINGUISHERS

Fire-fighting methods may be classified under the headings of (1) first-aid equipment; (2) permanently piped systems; and (3) large-scale portable equipment. This last class is the type employed by the regular fire company and is in reality a subdivision of Class (2) in that the fire-fighting medium is generally obtained from a permanently piped source of supply.

First-aid extinguishers are credited with the control of well over half of all fires. They are obtainable employing all of the types of extinguishing media previously mentioned. Among the simplest types are water buckets, bucket tanks and sand buckets. The standard bucket for fire use holds 12 qt. and is provided with a loose-fitting cover to prevent evaporation. If there is danger of freezing, a calcium chloride solution of the desired freezing point can be employed instead of water.

Probably more effective than the ordinary water bucket is the bucket tank or barrel which holds from 25 to 50 gal. A common arrangement is to nest six pails inside the tank. One type of pail has a counterweighted handle designed to rise into lifting position when the next higher pail is removed with its filling of water. Bucket tanks are generally equipped with a tight-fitting cover and rubber gasket.

Pump Tanks—A pump tank is a cylindrical vessel, closed at the top and built in 2½ and 5 gal. sizes. The tank is equipped with a carrying handle and a pump with a length of hose, capable of throwing a stream 35–40 ft. If desired, a non-freezing calcium chloride solution can be used. This equipment is suitable for fires in ordinary combustibles and is particularly useful for extinguishing fires overhead which would be difficult to reach with a fire bucket.

Soda-Acid Extinguishers—The soda-acid extinguisher is the most commonly

employed type. It is built in sizes ranging from 1¼ to 2½ gal. and consists of a vertical cylindrical pressure tank containing a charge of dilute sodium bicarbonate solution (1½ lb. in 2½ gal.) and a suspended bottle holding 66 deg. Bé. sulphuric acid (4 fl. oz. per 2½-gal. extinguisher). When the extinguisher is inverted, the acid mixes with the bicarbonate solution, producing a pressure of carbon dioxide gas, which is capable of discharging the contents of the extinguisher over a distance of 30–40 ft. for a period of about 1 minute. This type is also supplied in a wheeled model for industrial use, having a capacity of 20 or 40 gal., and throwing a stream 45–60 ft. for 3–5 minutes. Soda-acid extinguishers are used for fires in ordinary combustible materials but are unsuitable for flammable liquids and electrical equipment.

Gas Cartridge Extinguisher—One type of extinguisher which has been used in recent years in the 2½ gal. size is similar in appearance to the soda-acid extinguisher but uses plain water or calcium chloride anti-freeze solution as the filling and is provided with a cartridge of compressed carbon dioxide gas which supplies the necessary pressure for expelling the liquid. The extinguisher is operated by striking the top against the floor, causing a pin to puncture a seal in the cartridge and thus release the carbon dioxide. Performance and use are substantially similar to the soda-acid type.

Non-Freezing Extinguishers—As already noted, both the pump tank and the carbon-dioxide-powered water extinguisher can be provided with anti-freeze solutions. Another type of anti-freeze extinguisher has a bottle of sulphuric acid and a special potassium carbonate solution in a small inner container. The extinguisher proper is filled with calcium chloride solution. When the extinguisher is inverted, mixture of the acid with the carbonate solution forms sufficient carbon dioxide pressure to expel the calcium chloride solution. The acid in this extinguisher is protected by sealing with a layer of non-volatile liquid to prevent absorption of water vapor and raising of the freezing point.

Loaded Stream Extinguisher—This is a type of anti-freeze extinguisher made in 1–2½ gal. sizes, containing a special solution of alkali metal salts, the propelling pressure being provided either by a carbon dioxide cartridge or by a chemical reaction. These salts exert a special extinguishing action. On Class A fires they extinguish the flame rather suddenly and produce a fireproofing effect. On Class B fires, without blanketing the fire, they nevertheless produce a chemical action, tending to inhibit oxidation.

Foam Extinguishers — Hand-type foam extinguishers come in 1¼ or 2½ gal. sizes and are similar in appearance to the soda-acid type. Larger portable foam extinguishers are made in 10, 20 and 40 gal. sizes. In all of these the main tank holds a solution of sodium bicarbonate to which a foaming agent has been added. A secondary tank mounted inside the first is a long metal tube containing a solution of aluminum sulphate. When the extinguisher is inverted, the reaction between the aluminum sulphate and the bicarbonate solution produces carbon dioxide gas, which under the influence of the foaming agent, produces a foam having about 7½ to 8½ times the volume of the original solution. The pressure of the gas projects the foam from the hose a distance of about 35-45 ft. for the 2½ gal. extinguisher.

Foam forms a blanket which floats on the surface of most liquids, persisting for some time and thus preventing re-ignition of the fire. Ordinary foam, however, is relatively ineffective on fires in liquids such as alcohols, acetone, butyl and amyl acetates. These liquids are partly or completely soluble in water and apparently tend to cause partial or complete disintegration of the foam. Several manufacturers now supply special foam producing chemicals especially for such hazards. These chemicals are, however, approved only for use in the so-called single-powder generators referred to below, and not for first-aid equipment.

Foam is a good conductor of electricity and must not be used on live electrical apparatus. It is not as well suited to fires in ordinary combustible materials as water extinguishers. Foam solutions are not freeze-proof and therefore should not be exposed to freezing temperatures.

Carbon Dioxide — Portable carbon dioxide extinguishers are made in nine sizes ranging from 2 to 100 lb. of CO_2 capacity. These are all of the high pressure type in which the carbon dioxide is stored as a liquid at a pressure of about 850 lb. per sq. in. at normal temperature. Tank-truck type carbon dioxide equipment is also available in much larger capacities (3 tons) with the liquid CO_2 maintained at a temperature of about 0 deg. F. by means of refrigeration and at a pressure of about 300 lb. The latter type is used in the fighting of airport and certain industrial fires.

The ordinary portable CO_2 extinguisher consists of an I.C.C. approved steel cylinder fitted with a quick-opening valve and a length of high pressure flexible hose terminating in a specially designed discharge assembly and conical fiber horn to provide for proper expansion of the gas. In the 2-lb. type, a swivel tube is provided instead of a flexible hose. These units discharge a combination of carbon dioxide gas and snow, having an effective range of from 2 to 8 ft. and a continuous discharge of from 15 to 110 sec. depending upon the size of the extinguisher. Most extinguishers of recent design can be discharged intermittently. This method of extinguishment operates by blanketing the fire with a heavy inert gas, thus depriving it of the oxygen required for combustion. In addition, a small amount of cooling is accomplished, since the snow is at a temperature of −110 deg. F.

Carbon dioxide is non-injurious, non-corrosive and a non-conductor of electricity. Such extinguishers will not freeze nor does the contents deteriorate with age. Carbon dioxide can be used for extinguishing fires in small quantities of flammable liquids and is particularly suited to applications which break down foam. This material is also well adapted for electrical fires.

Carbon Tetrachloride—The so-called vaporizing liquid extinguisher employs a specially prepared carbon tetrachloride, treated to remove corrosive substances and to lower its freezing point. Ordinary carbon tetrachloride should never be used in such extinguishers. Extinguishers range in size from 1 qt. to 3 gal. They operate by reason of the heavy vapor formed when CCl_4 vaporizes, blanketing the fire. The cooling effect of the evaporation is less than with water. Three types of vaporizing liquid extinguisher are available including the pump type, the air pressure type and the carbon dioxide pressure type. Pump type extinguish-

Carbon dioxide discharged at a high rate from a Cardox bulk storage fire truck built for Cramp Shipbuilding Co. rapidly deals with a gasoline fire

ers are made in sizes from 1 qt. to 2 gal. and consist of a container with an integral pump for discharging the liquid. The air pressure type is built in sizes from 1 to 3 gal. and contains a pump by means of which air at a pressure of 100 lb. per sq. in. can be stored in the extinguisher, ready to discharge the liquid when needed. Such extinguishers are equipped with a pressure gage and should be inspected periodically to detect loss of pressure. The third type, made only in the 1 qt. size, contains carbon dioxide gas under pressure above the surface of a mixture of carbon tetrachloride and methyl bromide. When the valve is opened the liquid discharges. Extinguishers of the vaporizing liquid type are particularly suitable for use on electrical apparatus and also on flammable liquid fires in confined spaces. They should not be used, however, where the operator will be unduly exposed to the fumes liberated, since carbon tetrachloride breaks down at high temperature to some extent, forming toxic gases.

Dry Chemical Extinguishers—The only approved dry chemical extinguisher at present manufactured in the United States employs a specially prepared sodium bicarbonate mixed with other materials to prevent caking, which is discharged from the apparatus through a hose under pressure of carbon dioxide or nitrogen gas released from a sealed metal cartridge. When operated, these extinguishers discharge a heavy cloud of dust on to the burning material, blowing away the flame and smothering the fire. The hand type, which resembles a soda-acid extinguisher, employs a sealed cartridge containing 6¼ oz. of carbon dioxide. In operation this is pierced by turning down a handwheel at the top and the carbon dioxide expels the powder through a hose. In the wheeled type, a steel tank holding 150-350 lb. of chemical is mounted on a carrier, together with a cylinder of nitrogen to force the dry chemical through a 50-ft. hose. Extinguishers of this type are suitable for use on flammable liquids in open tanks or on

Table I—Properties of Flammable Materials

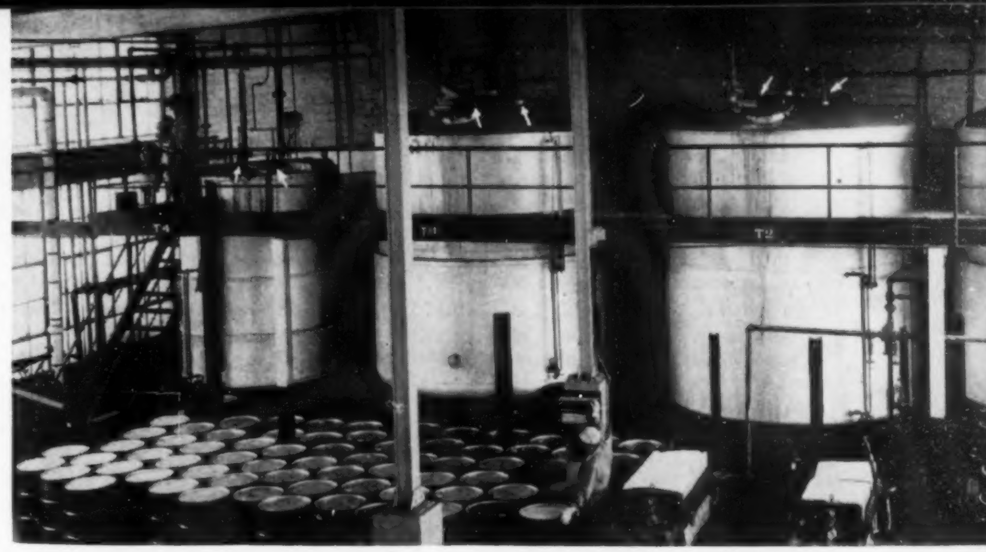
(Condensed by permission from Factory Mutual Data Sheet No. 36.10 (Jan. 1940), published by Inspection Dept., Associated Factory Mutual Fire Ins. Cos. Note: Numbers in parentheses after material name indicate suitable extinguishing agents. (1) Water; water spray behaves differently from solid stream, in general being suitable for fires in flammable liquids having flash point above 150 deg. F. (2) Foam. (3) Carbon dioxide. (4) Dry chemical. Asterisk (*) indicates material subject to spontaneous heating.)

Name	Flash Point, Deg. F.[1]	Explos. Range, %[2]	Auto-ignition Temp., Deg. F.	Sp. Gr., Water =1	Vapor Density, Air=1
Acetaldehyde (1,3,4)	–17	4.0 –57.0	365	0.783	1.52
Acetic Acid (Glacial) (1,3,4)	104	4.0 –....	1050	1.05	2.07
Acetic Anhydride (1,3,4)	121	... –....	752	1.08	3.52
Acetone (3,4)	0	2.15–13.0	1118	0.792	2.00
Acetyl Chloride (1,3,4)	40	... –....	...	1.105	2.70
Aldol (1,2,3,4)	181	... –....	....	1.11	3.04
Allyl Alcohol (3,4)	70	3.0 –....	713	0.854	2.00
Amyl Acetate-n (3,4)	76	1.1 –....	714	0.879	4.49
Amyl Alcohol-prim. iso (3,4)	109	... –....	667	0.813	3.04
Aniline (2,3,4)	168	... –....	1418	1.022	3.22
Anthracene (1,2,3,4)	250	0.63–....	881 in O_2	1.25	1.15
Anthraquinone (1,2,3,4)	365	... –....	....	1.438	7.16
Asphalt (Typical) (1,2,3,4)	400+	... –....	905	0.95–1.1	....
Benzaldehyde (1,2,3,4)	148	... –....	....	1.05	3.66
Benzene (2,3,4)	12	1.4 – 8	1076	0.88	2.77
Benzoic Acid (1,3,4)	250	... –....	....	1.266	4.21
Benzyl Acetate (1,2,3,4)	216	... –....	862	1.06	5.17
Benzyl Alcohol (1,2,3,4)	213	... –....	817	1.04	3.72
Benzyl Chloride (1,2,3,4)	140	1.1 –....	....	1.103	4.36
Bromobenzene (1,2,3,4)	149	... –....	....	1.497	5.41
Butyl Alcohol-n (3,4)	84	1.7 –....	693	0.806	2.55
Butylene Glycol (3,4)	104	... –....	....	1.019	3.10
Butyl Lactate (2,3,4)	160	... –....	....	0.968	5.04
Butyl Propionate-n (2,3,4)	90	... –....	800	0.875	5.00
Butyraldehyde (3,4)	20	... –....	....	0.817	2.48
Butyric Acid-n (1,3,4)	170	... –....	....	0.960	3.04
Camphor (1,2,3,4)	150	... –....	871	0.999	5.24
Carbitol (1,3,4)	201	... –....	....	0.99	4.62
Carbitol Acetate (1,3,4)	225	... –....	....	1.013	6.07
Carbon Disulphide (1,3,4)	–22	1.0 –50	257	1.256	2.64
Carnauba Wax (1,3,4)	540	... –....	....	....	....
Castor Oil* (1,2,3,4)	445	... –....	840	0.96	....
Cellosolve (3,4)	104	2.6 –15.7	460	0.931	3.10
Chlorobenzene (2,3,4)	90	... –....	....	1.11	3.88
Coal Tar Pitch (1,2,3,4)	405	... –....	....	....	....
Cocoanut Oil* (1,2,3,4)	420	... –....	....	0.91	....
Corn Oil* (1,2,3,4)	490	... –....	....	0.92	....
Cottonseed Oil* (1,2,3,4)	590	... –....	650	0.925	....
Creosote Oil (1,2,3,4)	165	... –....	637	>1	....
o-Cresol (1,2,3,4)	178	... –....	....	1.05	3.72
p-Cresol (1,3,4)	187	... –....	....	1.04	3.72
Crotonaldehyde (3,4)	55	2.95–15.5	....	0.853	2.41
Cyclohexane (2,3,4)	1	1.31– 8.35	....	0.779	2.90
p-Cymene (2,3,4)	117	... –....	921	0.86	4.62
Denatured Alcohol—95% (3,4)	60	... –....	....	0.82	1.60
Diacetone Alcohol (comm'l) (3,4)	48	... –....	....	0.931	4.00
Dibutyl Ether-n (3,4)	77	... –....	....	0.769	4.48
Dibutyl Phthalate-n (1,2,3,4)	315	... –....	....	1.045	9.58
o-Dichlorobenzene (1,2,3,4)	151	... –....	....	1.325	5.07
p-Dichlorobenzene (1,3,4)	150	... –....	....	1.458	5.07
Diethanolamine (1,3,4)	....	... –....	1224	1.097	3.65
Diethyl Carbitol (1,3,4)	....	... –....	....	0.908	....
Diethyl Carbonate (2,3,4)	77	... –....	....	0.977	4.07
Diethylene Glycol (1,3,4)	255	... –....	444	1.119	3.66
Diethylene Oxide (3,4)	65	1.97–22.2	....	1.035	3.03
Diethyl Ether (3,4)	–20	1.7 –48.0	366	0.71	2.55
Diethyl Sulphate (1,2,3,4)	220	... –....	....	1.184	5.31
Dimethyl Aniline (1,2,3,4)	145	... –....	700	0.956	4.17
Dimethyl Ether (3,4)	–42	... –....	....	....	1.617
Dimethyl Sulphate (1,2,3,4)	182	... –....	....	1.332	4.35
Dinitro Toluene-2, 4 (1,3,4)	....	... –....	....	1.52	6.27
Diphenyl (1,3,4)	235	... –....	....	1.041	5.31
Diphenylamine (1,3,4)	307	... –....	....	1.16	5.82
Diphenyl Oxide (1,2,3,4)	239	... –....	....	1.073	5.86
Divinyl Ether (3,4)	<–22	1.7 –27.0	680	0.774	....
Ethanolamine (1,3,4)	....	... –....	....	1.02	2.10
Ethyl Acetate (3,4)	24	2.18–11.5	907	0.899	3.04
Ethyl Acetoacetate (1,3,4)	184	... –....	....	1.03	4.48
Ethyl Alcohol (3,4)	55	3.28–19	799	0.79	1.59
Ethyl Benzene (2,3,4)	59	... –....	....	0.868	3.66
Ethyl Butyrate (3,4)	78	... –....	....	0.879	4.00
Ethyl Chloride (3,4)	–58	3.6 –14.8	....	0.910	2.22
Ethylene Diamine (3,4)	93	... –....	....	0.890	2.07
Ethylene Dichloride (1,2,3,4)	56	6.2 –15.9	775	1.258	3.42
Ethylene Glycol (3,4)	232	... –....	775	1.113	2.14
Ethylene Oxide (3,4)	....	3 –80	804	0.887	1.52
Ethyl Formate (2,3,4)	–4	3.5 –16.5	....	0.922	2.55
Ethyl Lactate (3,4)	115	... –....	....	1.03	4.41
Furfural (1,2,3,4)	140	2.1 –....	739	1.150	3.31
Gasoline (2,3,4)	–50	1.3 – 6	495	0.75	3–4
Glycerine (1,3,4)	320	... –....	739	1.26	3.17
Hydroquinone (1,3,4)	329	... –....	....	1.332	3.81
Kerosene (2,3,4)	100–165	... –....	490	<1	....
Linseed Oil* (1,2,3,4)	435	... –....	820	0.93	....
Lubricating Oil, Cylinder (1,2,3,4)	....	... –....	783	<1	....
Menhaden Oil* (1,2,3,4)	435	... –....	828	0.927	....
Methyl Acetate (3,4)	15	4.1 –13.9	935	0.925	2.56
Methyl Alcohol (3,4)	54	6.0 –36.5	878	0.792	1.11
Methyl Amine (3,4)	0	... –....	....	0.699	....
Methyl Butyrate (2,3,4)	57	... –....	....	0.898	3.52
Methyl Carbitol (1,3,4)	....	... –....	....	1.035	4.14
Methyl Cellosolve (3,4)	107	... –....	551	0.966	2.62
Methyl Ethyl Ether (3,4)	–35	2 –10.1	374	0.697	2.07
Methyl Ethyl Ketone (3,4)	30	1.81–11.5	....	0.805	2.41
Methyl Formate (3,4)	–2	5.0 –22.7	840	0.975	2.07
Methyl Salicylate (1,2,3,4)	214	... –....	850	1.182	5.24
Naphtha, Safety Solvent (2,3,4)	100–110	1.1 – 6.0	450–500	<1	....
Naphtha, V. M. & P. (2,3,4)	20–45	1.2 – 6.0	450–500	<1	....
Naphthalene (1,3,4)	174	0.9 –....	1053	1.145	4.42
Naphthol, beta (1,3,4)	307	... –....	....	1.22	4.97
p-Nitroaniline (1,3,4)	390	... –....	....	1.437	....
Nitrobenzene (1,2,3,4)	190	... –....	924	1.2	4.25
p-Nitrotoluene (1,3,4)	223	... –....	....	1.286	4.72
Oleic Acid* (1,2,3,4)	372	... –....	685	0.891	....
Olive Oil* (1,2,3,4)	437	... –....	826	0.910	....
Ozokerite (1,3,4)	236	... –....	....	0.95	....
Palm Oil* (1,2,3,4)	421	... –....	650	0.92	....
Paraffin Wax (1,3,4)	390	... –....	473	0.9	....
Paraformaldehyde (1,3,4)	158	... –....	....	....	....
Pentane-n (2,3,4)	<–40	1.4 – 8.0	588	0.631	2.48
Perilla Oil* (1,2,3,4)	522	... –....	....	0.93	....
Petroleum, Crude (2,3,4)	20–90	... –....	....	<1	....
Phenol (1,3,4)	175	... –....	1319	1.07	3.24
Phenyl Cellosolve (3,4)	....	... –....	....	1.100	....
Phosphorous (Red) (1)	....	... –....	500	2.30	....
Phosphorous (Yellow) (1)	....	... –....	86	1.82	....
Phthalic Anhydride (1,3,4)	305	... –....	....	1.527	5.10
Picric Acid (1)	Explodes	... –....	<572	1.763	7.90
Pine Oil* (1,2,3,4)	172	... –....	....	0.86	....
Pine Tar* (2,3,4)	130	... –....	671	....	....
Propyl Acetate-n (2,3,4)	58	2.0 –....	....	0.886	3.52
Propyl Acetate-iso (2,3,4)	43	2.0 –....	860	0.877	3.52
Propyl Alcohol-n (3,4)	59	2.5 –....	812	0.804	2.07
Propyl Alcohol-iso (3,4)	53	2.5 –....	852	0.789	2.07
Propyl Alcohol-sec (3,4)	67	... –....	....	0.79	2.07
Pyridine (3,4)	68	1.8 –12.4	1065	0.982	2.73
Rape Seed Oil* (1,2,3,4)	325	... –....	836	0.915	....
Resorcinol (1,3,4)	261	... –....	....	1.272	3.79
Soya Bean Oil* (1,2,3,4)	540	... –....	833	0.925	....
Stearic Acid* (1,3,4)	385	... –....	743	0.847	9.80
Sulphur (1)	405	... –....	450	2.046	....
Sulphur Chloride (1,3,4)	245	... –....	453	1.687	3.31
Tannic Acid (1)	....	... –....	....	....	....
Tartaric Acid (1)	....	... –....	....	1.667	....
Toluene (2,3,4)	40	1.27– 7.0	1026	0.866	3.14
o-Toluidine (1,2,3,4)	185	... –....	900	0.999	3.90
p-Toluidine (1,3,4)	188	... –....	900	0.973	3.90
Triethanolamine (1,3,4)	355	... –....	....	1.13	5.14
Tung Oil* (1,3,4)	552	... –....	855	0.94	....
Turpentine* (2,3,4)	95	0.8 –....	488	<1	....
Vinyl Acetate (2,3,4)	18	... –....	800	....	....
Vinyl Chloride (3,4)	....	4 –22	....	0.97	2.15

[1] Closed cup method.

[2] Range from lower to upper limit, percent by volume in air.

the floor, as well as for ordinary fires in electrical equipment. However, the material should carefully be removed from electrical contact surfaces after the fire. This method has a maximum range of about 10 ft., thus limiting such extinguishers to relatively small fires where re-ignition is not likely to take place.



Kidde carbon dioxide nozzles permanently installed in these tanks (nozzles shown by arrows) protect the plant against flammable solvent hazard

PERMANENT SYSTEMS

Standpipes—A usual method of protection inside buildings is to provide one or more standpipes, often installed in stair wells, with a hose outlet at each floor level. A standpipe system designed for use of the occupants of the building generally employs 1½ or 1¼ in. hose with a ⅜ or ½ in. nozzle. A standpipe for use by the plant or municipal fire department has 2½ in. outlets. The first type is equipped with hose and a nozzle permanently installed. With the second type, the hose is generally not kept attached but is brought in by the fire department.

Hose—Fire hose is made in two general types, (1) rubber-lined, cotton-covered and (2) linen hose without lining. The first type is employed by both plant and municipal fire departments, while the second type, because it does not deteriorate in storage inside buildings as long as it is kept dry, is used for permanent attachment to standpipes. Rubber-lined cotton hose is made in 1½ and 2½ in. sizes with single, double and triple jackets, the heavier grades being for rough usage. For use around corrosive liquids or in corrosive atmospheres, a rubber-covered type is available. After use, rubber-lined hose must be cleaned and carefully dried before storing away. The standard length is 50 ft. Each length of hose is equipped with standard couplings having a swivelling threaded section operated by a special spanner. Today practically all plant fire connections are of the same thread standard used by municipal agencies.

Hose Houses—For outside use around the plant, hose houses are often built over hydrants. At least 100-150 ft. of 2½ in. rubber-lined hose, should be permanently attached to the hydrant and supported on a shelf, so folded forward and backward as to ventilate properly. A second shelf will carry two or more additional rolls of hose. In addition, the plant fire department may be equipped with one or more hose carts carrying up to 500 ft. of 2½ in. rubber-lined hose. Carts should be stored in an outside building, such as a small, ventilated cart house.

Nozzles—The standard 2½ in. play pipe is a nozzle 30 in. long, equipped with a 1⅛ in. cylindrical orifice. Two handles are provided to assist in holding the nozzle. Other types include the lever-shut-off type, having a valve by means of which the stream can be shut off. Several spray nozzles are built, one kind being capable of producing a spray discharge angle anywhere in the range between 40 and 150 deg. One nozzle which throws a solid stream is adjustable to change the size of the stream between 1¼ and ¼ in. The type known as the monitor nozzle is intended for permanent installation in outdoor locations where large amounts of combustible material are stored, for example, log piles at pulp mills. This nozzle is connected directly to the piping, and is designed to swivel in any direction desired.

SPRINKLERS

Generally speaking, sprinklers are the most effective type of fire-fighting system for use where water can be employed. They are of numerous types. The ordinary overhead sprinkler employs many different kinds of sprinkler nozzles, as well as several different arrangements for bringing water to the nozzles. In addition, there is the fog type which has in recent years been found effective as a permanent installation for the extinguishment of both electrical fires and fires in flammable liquids. Sprinklers are also used for outside installation, under cornices, over windows, and on roofs, for the exposure protection of buildings.

Overhead Sprinklers—Sprinklers are almost always automatically operated, either through a fusible device installed in each sprinkler head or through a thermostat which opens the valve supplying the water. Water is fed to the sprinkler through a system of piping ordinarily attached to the ceiling, with sprinklers placed at intervals along the pipe, generally at a spacing of 80 sq. ft. per sprinkler. Heads should be placed in an upright position, unless a special pendant type is employed. Where the proper water supply is available, sprinklers have shown a remarkable record of effectiveness in fire control.

Depending on the ambient temperature, sprinklers are available to operate at various fixed temperatures ranging between 135 and 500 deg. F. Three methods of actuation of automatic sprinkler heads are employed: (1) The solder type, making use of a fusible link; (2) the bulb type employing a quartz glass bulb nearly filled with a liquid which expands as the temperature rises, eventually shattering the bulb at the operating temperature; and (3) the chemical type which has a small cylinder containing a low-melting chemical which fuses at the desired temperature. Standard sprinkler heads have either a ½ in. ring type discharge orifice or a $\frac{7}{16}$ in. tapered nozzle orifice. The orifice is ordinarily closed by a disk which is held tightly in place by means of the fusible or frangible element.

Sprinkler systems are of two general kinds including the wet-pipe and the dry-pipe types. In the wet-pipe system, the distribution piping is under water pressure at all times. In the dry-pipe system, the piping is maintained under an air pressure of 15 to 40 lb., the air pressure serving to keep the water valve closed. The dry-pipe type is employed where there is a possibility of freezing. Sometimes, in this case, a wet-pipe system is provided, using an anti-freeze liquid such as a calcium chloride or a glycol or glycerine solution. The wet-pipe type is set into operation by the fusing of one or more of the sprinkler heads, whereupon water immediately issues, rushing against a deflector which sprays it effectively over a considerable area. In the dry-pipe type, fusing of a sprinkler head permits the escape of the air which, when the pressure drops sufficiently, allows the water valve to open, after which the water flows through the pipe and out of the fused sprinkler head. The dry-pipe type, therefore, has a short lag which sometimes makes this system undesirable. In some dry-pipe systems, the automatic water valve is designed to use relatively low air pressure, thus resulting in a shorter lag.

Deluge Systems—For hazards requiring large amounts of water over the entire area in which a fire may originate, the so-called deluge system is employed. This makes use of a group of open sprinkler heads which are generally controlled by a thermostat. The method is used in extreme hazards where water damage is not likely to be a serious factor. Automatic control is provided either by fixed-temperature

thermostats which function when the temperature reaches a certain elevation, or by a rate-of-rise system which goes into operation only when the temperature rises more rapidly than at a predetermined rate.

Pre-Action System—One type of thermostatically controlled sprinkler system designed particularly for use where there is danger of serious water damage is known as the pre-action system. In this method the pipes are normally dry. The action of a thermostat releases a pre-action valve, the water fills the piping system and an alarm is given in advance of the fusing of the sprinkler heads. Frequently the sounding of the alarm gives an opportunity to extinguish the fire by hand before the sprinklers go into operation. On the other hand, should one or more sprinkler heads fuse immediately, this system obviates most of the operating delay of the ordinary dry-pipe system.

Sprinkler Alarms—Sprinkler systems are customarily equipped with a water-flow alarm which is designed to give warning of the sprinkler's operation the instant water flow starts. Both water motor alarms and electric actuated alarms are used. The electric alarm has the advantage that it is able to transmit a warning over any desired distance.

Fog and Spray Systems—Although water which does not contain foam-forming chemicals is not ordinarily considered as suitable for use on flammable liquids with which it is not miscible, nevertheless in recent years excellent results have been obtained with spray producing nozzles. An example is the so-called Mulsifyre projector originally developed in England which discharges water in the form of a well distributed spray. This strikes with considerable force on the surface of the liquid being protected and is stated to form a temporary oil-in-water emulsion. Such projectors are connected to specially designed pipe systems and spaced a few feet apart, at distances ranging from a few inches to as much as 24 ft. from the surfaces being protected. This system is claimed to be effective on all flammable oils and to be suitable for use on electrical fires. It operates at pressures between 45 and 100 lb. per sq. in. Other fog nozzles are available operating at lower pressures. In general, however, these nozzles, whether portable for use on ordinary hose or permanently piped, have not been approved by Factory Mutual Laboratories for use on flammable liquids more hazardous than kerosene. Most types are approved for use on live electrical equipment.

Foam Systems—Permanently installed fire protection systems employing foam are used very extensively, notably in the petroleum industry. Foam is gradually broken down by intense heat and by vigorous agitation and therefore must be applied at a sufficient rate and in sufficient volume to offset these effects. An application rate of ⅔ gal. of foam per sq. ft. per min. is usually adequate if the foam is applied to the surface of the flammable liquid without much agitation. Foam flows readily over open surfaces but does not penetrate well into cracks.

There are four principal methods of producing chemical foam in addition to a new mechanical foam method. In the first method, two foam producing chemical solutions are kept separate in the apparatus until ready for use, when they are mixed and discharged directly or through piping. This type is used for relatively small-scale protection. In the second type the two foam-producing chemicals are contained within the apparatus in dry form, being mixed into the stream of water at the time of discharge. This type is suited to moderate scale protection. The third type, the hopper type generator, is used both in fixed systems and for portable use to supply foam hose streams. The inlet of the generator is connected to a water supply of at least 50 lb. pressure and the outlet to the discharge system or hose. The stream of water in passing through automatically picks up the proper amount of powder from the hopper and foam is produced so long as powder and water are supplied to the unit. This type is used for large-scale protection systems. It is available in two varieties, one using a single foam-producing powder which contains all the necessary ingredients and the other two separate powders. Finally, there is the stored solution system which has now to a considerable extent been supplanted by generator systems. In this system the two foam-producing liquids are stored separately in tanks and pumped at the time of fire by means of a twin or duplex pump through a duplex piping system to a discharge outlet near the point of use where the solutions mix.

Mechanical Foam—A recently developed air-foam system employs a special play pipe and a tank containing a foam-producing solution. The play pipe exerts an aspirating effect on an air inlet and also on a suction pipe leading to the solution tank. As the solution is aspirated slowly into the water stream at the point where air is entrained, foam is produced at the rate of 275–300 gal. per gal. of foam-producing solution, and 12 to 14 gal. per gal. of water. In another air-foam system, air, water and a foam-producing powder are mixed in a power-driven generator operated by a gasoline engine, motor or turbine. This system is said to obtain up to 68 gal. of foam per lb. of powder.

Carbon Dioxide—Two types of permanently piped carbon dioxide protection systems are in use. In the more common type, a number of cylinders holding usually 50 lb. of the gas are connected to the piping system by a manifold. The gas is piped to the point of hazard where it discharges through flaring horns, either into specific hazardous equipment such as covered tanks or kettles, or around the walls of a room which is to be protected by total flooding. Discharge is accomplished by a thermostatic device which opens the discharge control valve after it sounds an alarm.

The second system stores liquid carbon dioxide in large quantities, from 1 to 125 tons, in a vessel which is refrigerated by means of a small self-contained refrigerating unit so that the temperature of the liquefied gas is maintained at about 0 deg. F. and the pressure at about 300 lb. Owing to the lower pressure of the second method, large quantities of liquefied gas may be stored in a single vessel of considerable diameter. Since larger quantities of gas can be stored, a higher release rate is possible. It is also claimed for the second method that the refrigeration of the gas results in the production of a greater proportion of snow to gas upon expansion to atmospheric pressure, thus giving about three times the cooling effect possible with the high pressure storage system. An automatically timed discharge is used. These methods are suitable for the protection of inclosed special hazards such as rooms or tanks containing flammable liquids; and for electrical equipment of all kinds.

Ordinarily it is only necessary to

This portable, wheeled carbon dioxide extinguisher, made by C-O-Two Fire Equipment Co., rapidly controls an electrical equipment fire in a transformer vault

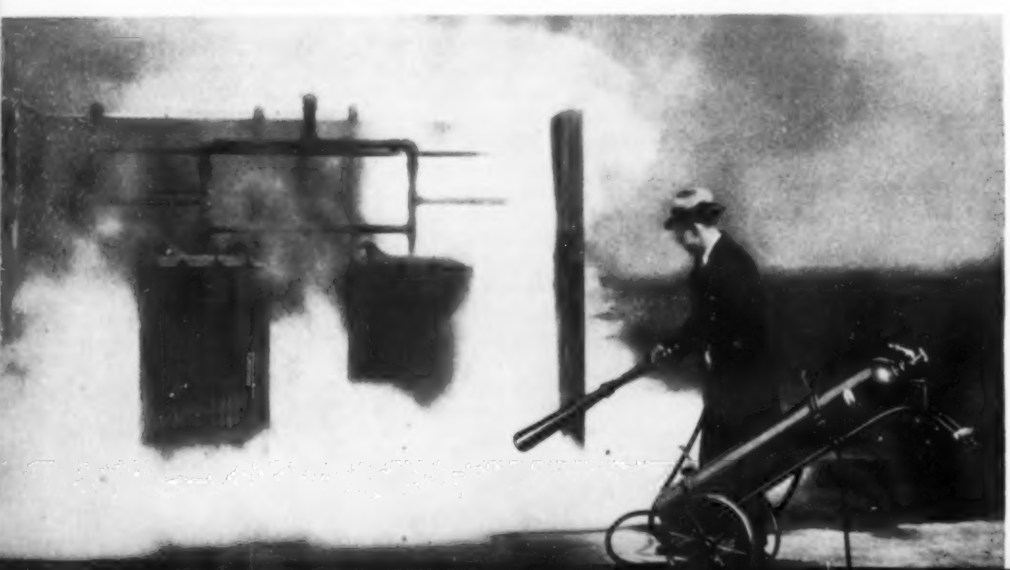


Table II—Sources of Information

In addition to municipal and state authorities who are generally glad to cooperate in matters of fire prevention and protection, there are a number of organizations in the field which are ready and willing to supply extremely valuable information. Some of these organizations issue booklets and pamphlets from time to time and a large amount of this literature is available. Among these organizations may be mentioned the following:

National Fire Protection Association—This organization, located at 60 Batterymarch St., Boston, is an association of national institutes, societies and organizations interested in fire protection, in addition to official and semi-official departments and bureaus, commercial firms, libraries, colleges and individuals. A non-profit organization, the N. F. P. A. develops fire protection standards, issues a quarterly periodical, and publishes a fire protection handbook and numerous bulletins and pamphlets. It holds an annual meeting, maintains a staff of field engineers who work with municipalities and it cooperates with municipal fire authorities and with volunteer fire groups. Publications available from the organization cover every conceivable phase of fire protection.

National Board of Fire Underwriters—This organization, located at 85 John St., New York, is an engineering, statistical and educational organization maintained by the stock fire insurance companies. A staff of trained engineers and investigators suggests fire prevention and protection measures, and cooperates with local authorities. The organization prepares codes and issues public educational material.

Underwriters' Laboratories, Inc.—This non-profit organization, having its main office and test station at 207 East Ohio St., Chicago, was organized primarily for the examination and testing of all manner of devices having a relation to life, fire and casualty hazards. The organization publishes periodical lists of tested and approved products in the fields of electrical equipment, fire protection equipment, etc., gas, oil and miscellaneous appliances, and appliances relating to accident hazard, automotive equipment and burglary protection. Listed products are followed up at frequent intervals. Many special investigations are publicized in bulletins.

Associated Factory Mutual Fire Insurance Cos.—This insurance system, specializing in industrial fire protection, maintains an inspection department and fire protection engineering laboratory at 184 High St., Boston. The organization includes a staff of 125 field engineers, who periodically inspect member properties and advise on hazards and protection. The laboratory carries out original developmental work on fire protection and engages in testing and approving of submitted protection equipment. Numerous publications are issued by the Inspection Department, covering the entire range of industrial fire protection, including pamphlets and bulletins on protective equipment, water supplies, safeguards for special hazards, standards of fire-safe construction, electrical equipment and recommended methods of organizing employees for plant protection.

U. S. Bureau of Standards—The National Bureau of Standards of the Department of Commerce does considerable work bearing on fire protection, especially is the field of fire resistance of materials. It investigates building practices and building codes and develops standards. Publications are issued on fire causes and fire hazards.

U. S. Department of Agriculture—The Bureau of Agricultural Chemistry and Engineering engages in considerable research work and field investigations, particularly on the subject of dust explosions in industrial properties, and on rural fire protection and spontaneous heating and ignition. Pamphlets are available.

National Safety Council—In general, the problem of industrial safety is split between the National Fire Protection Association—which deals with fire hazards and fire protection—and the National Safety Council, 20 North Wacker Drive, Chicago—which deals largely with the accident hazards. However, the National Safety Council has published considerable material on fire prevention, particularly with regard to industrial fires.

Bureau of Explosives—This organization, located at 30 Vesey St., New York, and maintained by the American Railway Association, prepares regulations for the transportation of explosives and other dangerous articles, covering containers, methods of handling and other transportation requirements. The Bureau operates a laboratory to test materials and investigates fires and explosions. It also maintains an inspection service and carries out other activities in the interests of safe transportation.

Literature Sources

"Crosby-Fiske-Forster Handbook of Fire Protection." This handbook, now in its 9th edition, is published at five-year intervals by the National Fire Protection Association. The most thorough and complete collection of fire protection information available, the book covers such subjects as fire losses, fire protection organizations, laws and regulations, common hazards, special industrial hazards, fire retardant and resistant construction, prevention of water damage, water supplies, fire pumps, inside and outside protection, fire extinguishers, inspection and maintenance, private fire organizations, salvage, and other necessary information.

"Industrial Fire Hazards." This book, written by Dana and Milne in 1928 and published by Lakeview Press, Framingham, Mass., is now believed to be out of print and may be difficult to secure. However, if available, it is a valuable study, covering in considerable detail the characteristics, processes and fire hazards of numerous industries and of many chemicals and proprietary compounds.

"Organization and Training of Industrial Fire Brigades." This 120-page booklet, recently prepared by Captain John C. Klinck of the Memphis Fire Department, is available from the publishers, S. C. Toof & Co., P. O. Box 55, Memphis, Tenn., at a regular price of $1 per copy, with quantity discounts for industrial fire brigades. The book necessarily omits any discussion of specialized fire hazards, but describes in detail the tools of the firemen and their proper use, the types of fire protection equipment employed industrially, including such subjects as extinguishers, standpipes, sprinklers and alarms, and goes at considerable length into the organization of the industrial fire brigade, its activities at fires, both normal and those caused by enemy action. Although other literature sources, such as publications of the National Fire Protection Association, deal to some extent with the industrial brigade, so far as is known, this booklet is the most complete treatment of the subject currently available.

"Protection for Industrial Plants." This pamphlet, published by the Office of Civilian Defense, Washington, D. C., will probably be available before this *Chem. & Met.* report reaches its readers. It is stated to deal in considerable detail with the whole problem of industrial fire protection, particularly with respect to the hazards of enemy action.

Periodicals—*Fire Engineering*, monthly periodical circulating largely among professional fire officers, firemen and fire protection engineers, published by Case-Shepperd-Mann Publ. Corp., 24 West 40th St., New York; *Quarterly* of the N. F. P. A., published in Jan., Apr., July and Oct. of each year; *Volunteer Firemen*, published monthly by the N. F. P. A., specifically for volunteers; *Factory Mutual Record*, published monthly by Associated Factory Mutuals, dealing with fires and causes, equipment and apparatus, prevention and protection.

Publications of N. F. P. A.—Lists of publications on hand for distribution are available from this organization. One list covers special published material dealing with war-time fire protection. Another covers all available publications on fires, fire prevention and fire protection. In most cases, a nominal price is charged for these publications when ordered by non-members.

Publications of Associated Factory Mutuals.—Numerous data sheets are published by the inspection department of this organization dealing with specific hazards, construction methods and fire protection methods, in addition to the monthly mentioned above.

reduce the oxygen content of the atmosphere surrounding the fire to about 15 percent although certain special hazards require reduction to as low as about 5 percent.

Fire Alarms—Several methods are in use for the automatic detection of fire so as to sound an alarm or release an extinguishing agent. There are two general types of thermostat used, the fixed temperature type and the rate-of-rise type. The first is used where ambient temperatures are not subject to great change, the latter in applications where solar or process heat might set off a fixed temperature alarm. Fixed temperature thermostats are either assemblies of spot devices located at specified intervals along the ceiling or roof, or of a continuous line type giving the alarm when subjected to a predetermined temperature at any point along the line.

Fixed types are designed to operate at temperatures similar to automatic sprinklers, for example, 135, 165, 212, 286 or 360 deg. F. Some use a fusible or frangible element such as a link or quartz bulb, others a bimetal. One type of rate-of-rise alarm is pneumatic, having an air leak which vents a slow rise in pressure due to temperature increase, but permits a pressure increase in event of a rapid temperature rise, either closing a contact or operating controls through a mechanical bellows arrangement. Another uses two bimetals, one of which is partially protected from the heat source so that on a slow rise they move substantially together, but one moves faster than the other on a rapid rise, so as to close a contact. One type of continuous line alarm uses a special wire with a fusible core. When the core melts, it flows through apertures in an insulating sheath between inner and outer conductors and completes the alarm circuit. The electric eye is also used to some extent for fire and particularly for smoke alarms.

WATER SUPPLY

Public Water Supply—Although many process plants are able to take advantage of public water supply, most such plants will nevertheless require their own water storage to supplement the public supply or to furnish the primary source of water when public supplies are insufficient in volume or pressure or lack dependability. For industrial use, the pressure of the public supply is frequently insufficient, requiring the plant to have fire pumps which may be of centrifugal, rotary or reciprocating construction. In a common arrangement, the pump is installed in a bypass line, between the

public main and the plant system. Or the pump suction may be provided with water from a suction tank or reservoir, at or near ground level, to provide a reserve in addition to the public supply.

Reserve Supply—Tanks are used to a large extent to supplement public supplies. Occasionally a private reservoir may be feasible, but ordinarily an elevated tank high enough to provide water to the highest sprinkler or capable of projecting a hose stream at least 40 ft. above the highest building is the best solution. Pressure tanks are sometimes used in congested areas where little storage space is available. When the tank is called upon to supply hose lines from hydrants, a capacity of 30,000 gal., with the bottom not less than 75 ft. above the ground, is usually considered minimum. When the tank is to supply sprinklers, the minimum specified capacity is 5,000 gal. and the bottom of the tank should not be less than 35 ft. above the highest sprinklers. Considerably larger tanks, however, are generally used. When an outside gravity supply tank is chosen, it is necessary to provide means for heating the tank water in winter to avoid the possibility of freezing. The commonest method of accomplishing this is to provide a steam-heated tubular water heater which takes cold water from the base of the standpipe, heats it with steam and induces a thermal circulation upward through a riser having several outlets in the tank proper.

Pressure Tanks—Such tanks should be located above the highest sprinklers they supply, except those at the top story of the building. A tank of 3,000 gal. capacity suffices for light hazards. The tank is kept about two-thirds full of water with air pressure of at least 75 lb. maintained over the water by means of a small air compressor.

PRIVATE FIRE BRIGADES

Many plants have found it expedient to organize private fire brigades. Ordinarily, the brigade is composed of volunteers from various departments of the plant, although in very large plants it sometimes takes the form of a full-time fire department composed of professional fire-fighters. Where processes are of such a special nature as to require extremely specialized fire-fighting knowledge, the private brigade is often in a better position to understand the situation than the public fire department and thus is available to assist and direct the professional department if and when it is necessary to bring the latter to the plant.

Authorities consider that the organization of, and responsibility for, a private fire brigade are directly in the hands of the highest officers of a plant. Furthermore, it is considered necessary that the plant fire department be recognized by the management as an important permanent department if its success is to be assured. The chief of the fire brigade should report to, and be responsible to, the highest executive in the plant organization and members of the brigade should be made to feel that their membership gives them special honor or privilege.

To be effective, a plant fire brigade must be subject to rigid discipline, it must be provided with the apparatus required by the role it is to play, and it must be adequately trained under discipline in actual use of the apparatus. It should have its own constitution and by-laws and hold regular meetings. Its chief should be a man with at least some fire training. In large plants, the heading of the fire brigade should be his sole job. If possible, a man with former fire department experience is desirable. Otherwise, one with mechanical aptitude and training, such as the master mechanic or the maintenance chief, may be a good choice.

The plant fire chief must be given full responsibility, not only for training and drilling of the men, and for the maintenance and testing of the apparatus, but also for the conduct of actual fire fighting. Furthermore, changes in the plant or process should be reviewed and approved by him to the extent that they affect the fire protection scheme of the plant and its fire hazards.

So far as the actual organization is concerned, this will depend to a considerable extent on the size of the plant and the character of its operations. For example, a plant having numerous special hazards will require quite a different type of fire-fighting organization than one in which the bulk of the hazards are of an ordinary nature. Particularly in the plant having numerous special hazards is it desirable to recruit operators from the special-hazard departments who are thoroughly familiar with the character of the hazards, the nature of the equipment, and the location of all valves and pipelines.

Every fire brigade, no matter how small, should have an assistant chief who is able to take over in event of the absence of the chief. Larger brigades having more than one company will also require captains for the several companies. A single company should ordinarily consist of not less than ten men. It is desirable that one company in larger plants should be composed of mechanics having special qualifications including electricians, steam and pipe fitters, cutting torch operators and maintenance men.

In so far as possible, every member of the plant brigade should be made familiar with all special hazards of the plant, with the extinguishment peculiarities of certain processes, principally those where water should not be used, and with the location of all hydrant houses, chemical engines, hose carts, standpipes, sprinkler valves and first aid fire extinguishers.

Many books and bulletins are available to assist in training the brigade, some of which are noted in Table II on page 103. Drills should be held at least twice a month, generally on company time. These drills should make use of the regular fire-fighting equipment and should familiarize the men with all conditions and parts of the plant and enable them to deal with any emergency which may arise.

Cooperation with the municipal fire department is obviously of great importance. Many plants make a regular practice of inviting the local companies to the plant at regular intervals, to inspect the property and familiarize themselves with the arrangement of buildings and with special hazards. This is particularly desirable in the case of those plants where the requirement of specialized extinguishment methods makes it necessary for the municipal company to operate only under the direction of the plant chief.

One important factor in cooperating with the municipal fire department is to make certain at all times that apparatus can get through the plant gates and to the scene of a plant fire with the least possible delay. Roads should be maintained clear and watchmen should be instructed to leave yard gates open in case of fire and be ready to direct fire apparatus to the point of trouble. When a plant has railroad tracks, it is important that cars should not be left so as to block important crossings.

ACKNOWLEDGMENTS

Chem. & Met. particularly wishes to acknowledge the valuable assistance of the National Fire Protection Association, and of the Inspection Department of the Associated Factory Mutual Fire Insurance Cos., whose publications and instructive suggestions and advice were made available to the editors. In addition, assistance was rendered by manufacturers of fire protection equipment including American-LaFrance-Foamite Corp., Elmira, N. Y.; Buffalo Fire Appliance Corp., Buffalo, N. Y.; Cardox Corp., Chicago, Ill.; C-O-Two Fire Equipment Co., Newark, N. J.; Globe Automatic Sprinkler Co., Philadelphia, Pa.; B. F. Goodrich Co., Akron, Ohio; Grinnell Co., Providence, R. I.; Walter Kidde & Co., New York, N. Y.; National Foam System, Inc., Philadelphia, Pa.; Pyrene Mfg. Co., Newark, N. J.; and Safety Fire Extinguisher Co., New York, N. Y.

Much published information has been used freely by the editors, largely without specific acknowledgment. General acknowledgment for this material is hereby made, particularly to the organizations and companies mentioned above and to the authors and publishers of several of the books referred to.

Reprints of this 8-page Report are available at 25 cents per copy. Address the Editorial Department, Chem. & Met., 330 West 42nd St., New York, N. Y.

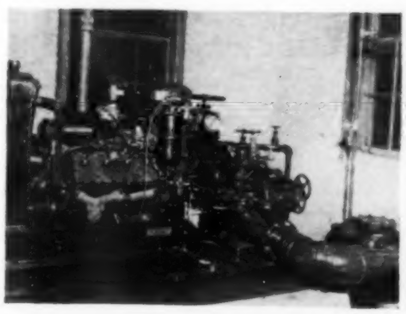
Machinery, Materials and Products

CHEM & MET PROCESS EQUIPMENT NEWS

Fire Protection Pumps

To PROVIDE moderate-cost fire protection for small plants, Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill., has developed a new Underwriters Laboratories approved fire pumping unit, consisting of one of this company's 4-in. centrifugal fire pumps, driven by a Ford-Mercury engine. The Mercury engine drive, turning at 2,500 r.p.m., is of sufficient speed to be direct connected, thus eliminating the need for gear drive, simplifying the installation and materially reducing installation and maintenance costs. An incidental advantage is that the engine can readily be serviced at any point in the country.

This company has also announced a new portable pumping unit available in a number of types, of which a typical example consists of a 2-in. nonclogging sludge pump, direct-connected to a 3-hp. splashproof motor mounted on a standard warehouse truck with 8-in. rubber-tired wheels. A small hand-operated bracket-type pump mounted on the truck platform, with its suction connected to the top of the centrifugal volute, is provided for priming. The particular unit mentioned has a length of 2½ in. wire-lined rubber suction hose and a length of 2½ in. collapsible cotton fabric discharge hose. Such units are suitable not only for various kinds of emergency service, but also for regular service in transferring materials between tanks.



Mercury-engine-driven fire pump

Sawing new Foamglas insulation

Cellular Glass Insulation

GLASS in a new form, never before manufactured, appears in the new cellular glass insulation material for use in cold rooms which has been introduced by Armstrong Cork Co., Lancaster, Pa., under the name of Foamglas. The new material is said to offer permanent insulating efficiency in numerous low-temperature applications. Its cellular structure results in the formation of a slight vacuum within the cells which is claimed to provide a highly efficient barrier to heat passage. Furthermore, the material is said to be positively proof against internal condensation and the passage of water vapor. It is fireproof and waterproof, it has sufficient structural strength to support an insulated ceiling and can be readily sawed and worked with ordinary tools.

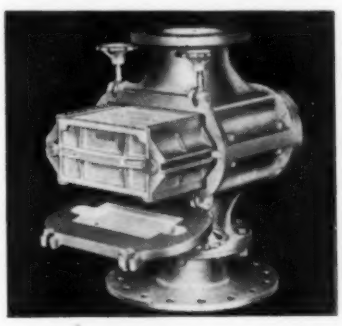
This material is made by firing ordinary glass which has been mixed with a small quantity of pure carbon. At the proper temperature the glass softens and the gas formed produces a cellular product which cools in hard, vitreous slabs. The material was developed and is made by Pittsburgh-Corning Corp., but is marketed exclusively in the low-temperature field by Armstrong Cork Co. Standard 12x18-in. blocks are available in various thicknesses from 2 to 6 in.

Spray Fire Nozzle

A NEW water-spray nozzle, known as the Alfcospray nozzle, has been developed by American-LaFrance-Foamite Corp., Elmira, N. Y., to meet demands for a variable, all-spray nozzle which cannot produce a straight stream. From the shut-off position a slight turn of the tip immediately gives a cone spray of 40 deg. Further slight rotation produces increasing cones up to a full curtain of 150 deg. The advantage of the nozzle is that it is impossible to produce a solid water stream inadvertently which might be applied to a live electric circuit. The varying cones are also said to be excellent for extinguishment of heavy oil fires and for general cooling purposes. This nozzle, known as Model 10F, is available for several hose sizes including 2½ in. In the 40-deg. spray position its capacity is about 95 g.p.m. at 50 lb. water pressure.

In its full curtain position, the new nozzle is said to provide an effective water screen to protect men and property. Furthermore, it is claimed to be more effective on Class A fires than a straight-bore nozzle.

Alfcospray nozzle set at 40 deg.



Flame arrester for tanks

Flame Arrester

To PROTECT tanks containing volatile, flammable liquids against fire hazards, the Johnston & Jennings Co., 877 Addison Road, Cleveland, Ohio, has announced the Oceco flame arrester which permits free passage of vapors, but offers a positive stop against flame entering the tank if the vapors should become ignited. This flame arrester is also employed to prevent the propagation of flame or explosion through pipe lines carrying explosive gases. The unit consists of a strong, rigid housing with a cover, containing an all-aluminum flame arrester element. The housing of cast semi-steel can withstand direct exposure to heat and flame. The arrester element consists of alternate flat and corrugated sheets of aluminum, arranged to present vertical straight-through passages to the flow of gas or vapor and minimize pressure drop, as well as any tendency to retain moisture and foreign materials. A net free area of the arrester element twice that of the pipe is provided. Available sizes range from 2 to 10 in. Units carry Underwriters Laboratories approval.

Among the claims made by the manu-

No. 42 controller

facturer is the statement that in numerous test installations of this equipment, no tight tank so equipped has ever been lost by fire, even when located in the middle of a blazing tank farm.

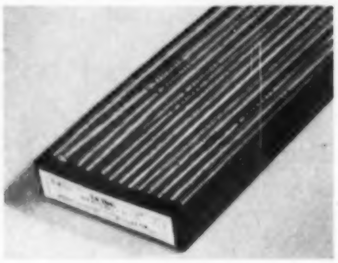
Non-Indicating Controller

SMALL SIZE, simple construction and accuracy of operation are claimed for a new non-indicating controller known as Tag No. 42 which has recently been placed on the market by C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y. The instrument is claimed to be suited to the majority of automatic control applications and employs thoroughly tested elements redesigned for compactness and simplicity. It is adapted to both temperature and pressure control in a number of convenient ranges.

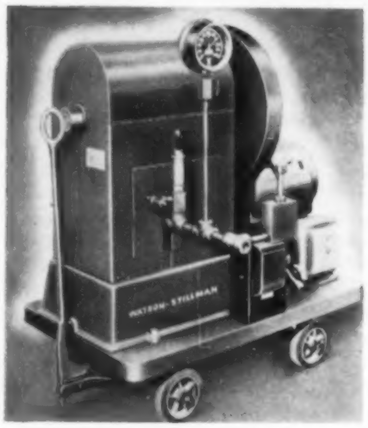
The company has also announced a new line of self-operating temperature controllers suitable for such applications as hot water storage heaters and tanks. The controller is of the type deriving its power from changes in the vapor pressure of a volatile liquid in the tube system. Sensitivity is achieved through the use of a small diameter valve stem equipped with a lubricator.

Hard-Facing Rods

To SUPPLY concerns unable to furnish high priority ratings, the Stoody Co., Whittier, Calif., has developed two new hard-facing-alloy welding rods which are being marketed under the trade names of Stoodite K and Stoody Self-Hardening K. The first rod produces deposits having an average hardness on the Rockwell C scale of 54-58, and is said to yield smooth dense deposits free from porosity and shrinkage cracks. This rod is recommended for hard-facing such equipment as cement mill parts and brick and clay equipment. The second rod is slightly less hard and is particularly adaptable to deposits on manganese steel. Deposits can be forged at a red heat. Applications for this rod include roll, jaw and gyratory crushers, and bucket



New hard-facing rod



High pressure test pump

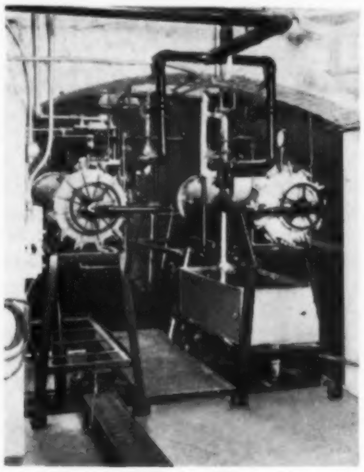
conveyors. Both types are available for either alternating or direct current welding. Both can be had under regular A-10, P-100 ratings. Further information can be obtained from Air Reduction Sales Co., 60 East 42d St., New York, N. Y.

Portable Test Pump

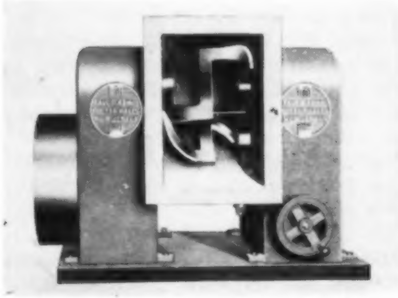
RAPID TESTING of pressure vessels, piping systems and boilers is the function of a new motor-driven portable test pump which is now being manufactured by the Watson-Stillman Co., Roselle, N. J. The unit is inclosed and is mounted, together with its motor, on a hand truck for portability. The pump is of the three-plunger vertical type with ½-in. diameter plungers having a 2-in. stroke. Driven by a 3-hp. motor at 100 r.p.m., the pump develops 8,200 lb. per sq.in. maximum pressure at ½ g.p.m. capacity. All necessary accessories are included.

Closed-Type Filters

AN ACCOMPANYING VIEW illustrates an improved type of filter developed by LeVal Filter Co., 1319 South Michigan Ave., Chicago, Ill., for applications requiring closed system filters which can be cleaned without opening or dismantling, especially in locations needinging explosion-proof electrical equipment, or where hazardous liquids and acids are to be handled. The units shown employ patented filterstones made in the shape of a hollow disk which in use are coated with a filter aid. The stones are supported in the center of the cylindrical tank and are



Closed-type filters



Improved double-arm mixer

revolved as they are backwashed and sprayed at the conclusion of the run. Initial tests for flow rates on an installation of this type, handling a water-thin highly corrosive product, gave 333 g.p.h. per sq.ft. of filter area for a pressure drop of 18 lb. across the stones. The units illustrated each contain 20 sq.ft. of filter area.

Improved Mixers

IMPROVED DESIGN, streamlined appearance and complete inclosure of the gears and stuffing box are featured in the redesigned line of Cincinnatus and Mastodon double-arm mixers recently announced by Paul O. Abbé, Inc., 375 Center Ave., Little Falls, N. J. The Mastodon heavy-duty-construction mixers are built in sizes from 3 to 150 gal. capacity, and the Cincinnatus lighter-construction mixers in sizes to 300 gal. The complete inclosure of the new mills reduces required operating space and assists in keeping the machines clean. The company's overlapping design of mixing blades is said to insure fast and efficient mixing action.

Burglar Alarm Control

FOR PROTECTION against intruders and saboteurs seeking to gain entrance to industrial plants, a new long-range photoelectric burglar alarm control has been developed and made available by Photoswitch, Inc., 21 Chestnut St., Cambridge, Mass. The new Type A28-L

control is suitable for both outdoor and indoor applications over very long ranges, employing a light source capable of projecting a practically invisible beam of light for distances of 350 to 700 ft. Thus, it is possible completely to surround the plant with several of these units. If the light beam is broken by an intruder, the photoelectric control contacts close thereby sounding an alarm, turning on floodlights, closing gates or performing other similar functions. The control is provided with a latching unit which latches the alarm in operation once the light beam has been momentarily broken, until a reset button is operated.

Changes in local light have no effect on the control which is designed for operation 24 hours a day.

Wooden Sash

OF INTEREST to all industrial plants contemplating new construction is the wooden, steel-saving "Victory Sash," recently developed and made available to industry by the firm of Albert Kahn Associated Architects and Engineers, Inc., New Center Bldg., Detroit, Mich. The organization has waived patent rights in order that the design may be available to all and will be glad to supply blueprints in detail to anyone interested.

The new development is said to be capable of serving industrial and other buildings quite as well as standard steel sash. Nevertheless, only a small amount of steel is required. Experience gained in the development of steel sash was called upon and the most of frame members common to old-fashioned wood sash were eliminated. Units are built complete in the mill and shipped to the job for erection, similar to steel sash. As units are erected, the mullions are joined by a coverplate of light, pressed metal with a small intervening space allowed for expansion and contraction. Caulking compound furnishes complete waterproofing. At the sills the wood sash is secured by metal clips clamped only at the mullions with regular mullion bolts. The design facilitates glazing and minimizes deterioration of the wood. Owing to probable difficulties with ventilator sections employing wooden framing, the new design calls for steel ventilators which, however, require only a small amount of steel compared with the amount of fixed wooden sash in a building. The design makes extreme height possible in single units, and thus means considerable saving in horizontal supporting members, while allowing maximum light for the amount of material used.

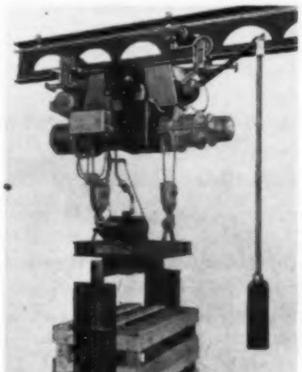
Photoelectric intruder detector

Albert Kahn and John Schurman, designer of the "Victory Sash," examine section of this new steel-saving factory window.

Box Grab-Carrier

A MOTOR-DRIVEN GRAB and carrier, designed especially for handling crates and boxes in and out of storage, or from one elevation to another, is one of the most recent developments of Cleveland Tramrail Division, the Cleveland Crane & Engineering Co., Wickliffe, Ohio. The unit enables quick stacking or removal of crates at a great height with safety. It is completely motorized, with all operations conveniently controlled by six buttons. If desired, the unit can be provided with an operator's cab in which all controls are located. As appears from the accompanying illustration, the arms of the grab are extended and retracted by motor-driven geared slide bars mounted on top of the grab. A double-hook cable-type electric hoist elevates and lowers the grab with a minimum of swing. A quick-acting electric brake stops and holds the load wherever desired.

Motor-driven box grab



Self-aligning idler

Belt Aligner

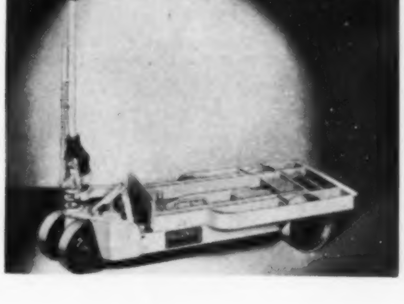
To INSURE the longest possible life of conveyor belts, Chain Belt Co., 1600 West Bruce St., Milwaukee, Wis., has announced a new self-aligning idler for flat conveyor belts, for use on both the return and carrying runs. The idler is designed to assist in keeping the belt central on its supporting idlers, thus avoiding edge wear. The operation of the new idler is said to be sensitive and instantaneous. If for any reason the conveyor belt runs to one side, it has a tendency to swivel the idler in a horizontal plane. If this in itself is not sufficient to cause the idler to swing enough to force the belt to throw back immediately, the belt will continue traveling to one side until it contacts a counterweighted end disk which is slightly larger in diameter than the idler roll. Contact with this disk tends to rotate it, but since it is counterweighted, it resists the tendency to rotate and produces a counter force on the idler, causing the latter to swivel rapidly and throwing the idler more out of line so as to force the belt to swing the other way immediately.

Where excessive misalignment of a conveyor belt exists, caused by such factors as stretch or weave in the belt, uneven loading of material on the belt, or shifting of the conveyor frame, several of these self-aligning idlers spaced at intervals between the stationary idlers are stated automatically to bring the belt back to central position and avoid the possibility of serious injury.

Heavy-Duty Lift Truck

To FILL OUT the company's present line of Weld-Built lift trucks, the West Bend Equipment Corp., West Bend, Wis., has announced development of a new 10,000 lb. capacity hydraulic lift truck designated as Model L. This

5-ton lift truck



model has all standard features common to other trucks of this company's line, including the company's shockproof, horizontally mounted hydraulic lift unit. Available in both narrow and wide platform types, it employs parts capable of handling much heavier loads than the specified rating. Moving parts are all supplied with ball or roller bearings for easy handling.

Equipment Briefs

A POWDER known as Magout, developed by Pulmosan Safety Equipment Corp., 168 Johnson St., Brooklyn, N. Y., has been announced for the extinguishment of magnesium fires. It is claimed to be equally suitable for both magnesium shavings and magnesium incendiary bombs. The material is nonabsorbent, does not deteriorate and can therefore be kept on hand either in bulk quantities, or in cardboard containers of a new type.

AN IMPROVED plastic pump in which the step-valve, inlet and discharge connections are made entirely from transparent plastics is being offered by Milton Roy Pumps, 1300 E. Mermaid Ave., Philadelphia, Pa. The pump is recommended for handling alum solutions, hypochlorites, weak acids, mineral and animal oils, since the "Plexiglas" valve is unaffected by most inorganic solutions and by alkalis and oxidizing acids only in high concentrations. The pump has double-ball ground glass checks and adjustable stroke for accurate control of volume from one quart per hour up to maximum capacity of 100 gal. per hr. for the Duplex models and 50 gal. per hr. for the Simplex models against pressures up to 150 lb. per sq. in.

FOR BLACKOUT alarms, Photoswitch, Inc., 21 Chestnut St., Cambridge, Mass., has developed the Photoswitch Photoelectric Blackout Alarm control. This control is placed in a convenient location so that it views a centrally controlled street lamp. Through the Photoswitch are connected alarm systems operating inside the factory and when the street lights are turned out, the control observes this and the alarm is sounded. The unit is designed to operate independent of a momentary flickering of the street lamp. It will provide an alarm system for factories and plants in which noise from the din of machinery, etc., makes it difficult to hear an external air raid warning siren.

BLACKMER PUMP Co., Grand Rapids, Mich., has announced a combination rotary-centrifugal dual pumping unit, comprising a cast bedplate on which is mounted a 4-hp. motor with a gearhead on one end to drive the rotary pumping unit, and a shaft extension on the other end, direct-connected to a centrifugal pump. The capacity of the first mentioned pump is 44 g.p.m. at 50 lb. per sq.in. (on a liquid such

New absolute pressure recorder

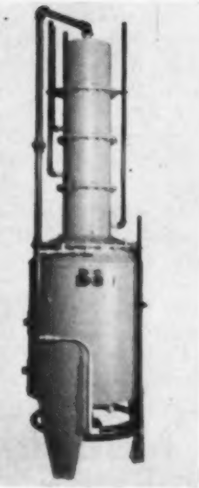
as oil), while that of the centrifugal pump is 75 g.p.m. at 25 lb. per sq. in. (on a liquid such as water). The unit is employed for applications in industrial plants where two dissimilar liquids must be handled together.

TO ASSIST research workers and others seeking instruments required in their work, but difficult to find, the National Research Council has recently appointed a committee on the location of new and rare instruments, of which D. H. Killeffer is chairman. Those needing the services of the committee should communicate with Mr. Killeffer at 60 East 42d St., New York, N. Y. On the other hand, the committee desires assistance from the owners and builders of instruments falling within the new and rare classifications, which might be made available to others through sale or for temporary use.

THE LINE of electric furnaces manufactured by H. O. Swoboda, Inc., 13th St., New Brighton, Pa., has recently been augmented by a new full-muffle electric box-type furnace with an all-refractory hearth, designed primarily for ceramic use at temperatures up to 2,000 deg. F. A new center-pivoted door decidedly simplifies construction. Chamber dimensions are 3¾x5¼x12 in.

Absolute Pressure Gage

FOR THE MEASUREMENT of pressures which are low enough to be seriously affected by variations in atmospheric pressure, Brown Instrument Co., Philadelphia, Pa., has developed and announced a new absolute pressure gage, said to have exceptionally high accuracy of calibration and a long life. In common with other instruments of the type, the gage measurement is the sum of the existing atmospheric pressure and the pressure of the measured substance above or below that of the atmosphere. The actuating elements consist of a spring and bellows assembly, including an upper evacuated bellows (sealed at nearly perfect vacuum) which contains a calibrating spring, and a lower actuating bellows connected to the source of measured pres-



Niagara "No-Frost" concentrator

sure. The top of the evacuated bellows and the bottom of the actuating bellows are fixed while the adjacent ends of the two bellows are attached through suitable linkages to the recording pen.

The action of the actuating bellows is the same as that of any ordinary bellows-actuated gage. However, the evacuated bellows expands or contracts with changes in atmospheric pressure and thus adds or subtracts a correction by producing a force equal but opposite to the varying atmospheric force on the actuating bellows. The instrument is available at present only as a single-record recorder or single-record air-operated controller. Ranges now available include 100, 200, 300, 400 and 500 in. of mercury absolute, and 15 lb. per sq.in. absolute.

Low Temperature Conditioner

NIAGARA BLOWER Co., 6 East 45th St., New York, N. Y., has announced availability of equipment for the air conditioning of cold rooms at temperatures as low as —50 to —80 deg. F., for use in processing and experimental work. The process, known as the "No-Frost" method, provides equipment for maintaining these low temperatures and also for introducing fresh make-up air without ice or frost forming on the cooler coils. Owing to this fact, the new equipment is said to give constant operation without interruption or loss of capacity. It employs this company's "No-Frost" liquid which is stated not to be a brine and not to be corrosive. The process employs coolers operated in stages, the first stage reducing the temperature to just above the freezing point of water and removing moisture condensing at this temperature. The second stage, employing the "No-Frost" liquid to remove the balance of the moisture, is made continuous by use of a concentrator for the liquid, as shown in the accompanying illustration. The third stage produces and holds the required final temperature.

The Mining and Refining of Diatomite

THE deposit of diatomite near Lompoc, Calif., supplies raw materials for filter aids, fillers and insulations. Where the Santa Ynez Range terminates in the hilly Point Conception region, lies one of America's most unique mineral deposits. It is a great bed of folded and stratified diatomite, the total thickness of which is 1,400 ft., and the area about 4,000 acres. This was first laid down several million years ago. It is formed of fossil diatoms, which are little microscopic plants having the capacity to form shells of nearly pure opaline silica. The individual particles of extreme fineness are of extraordinary structure and complex ornamentation.

At the Lompoc operations of Johns-Manville there are a well-integrated series of processes which cover the mining of the crude diatomite, transportation, preliminary drying, milling, classifying, and processing of powder products, the making of aggregates, the fabrication of insulating bricks, etc.

Operations are carried out simultaneously in a series of fully developed and selected quarries, making available a variety of raw materials for different products and for blending. Primary milling and blending of the wet crudes are carried out at a centralized plant located underground in solid diatomite. The distribution of crudes to the separate milling and processing units is by conveyor belts to storage and feeder bins. The accompanying drawing is a simplified flowsheet of operations beyond this point for one of four separate units. The pictures illustrate some of the essential operations in the process.

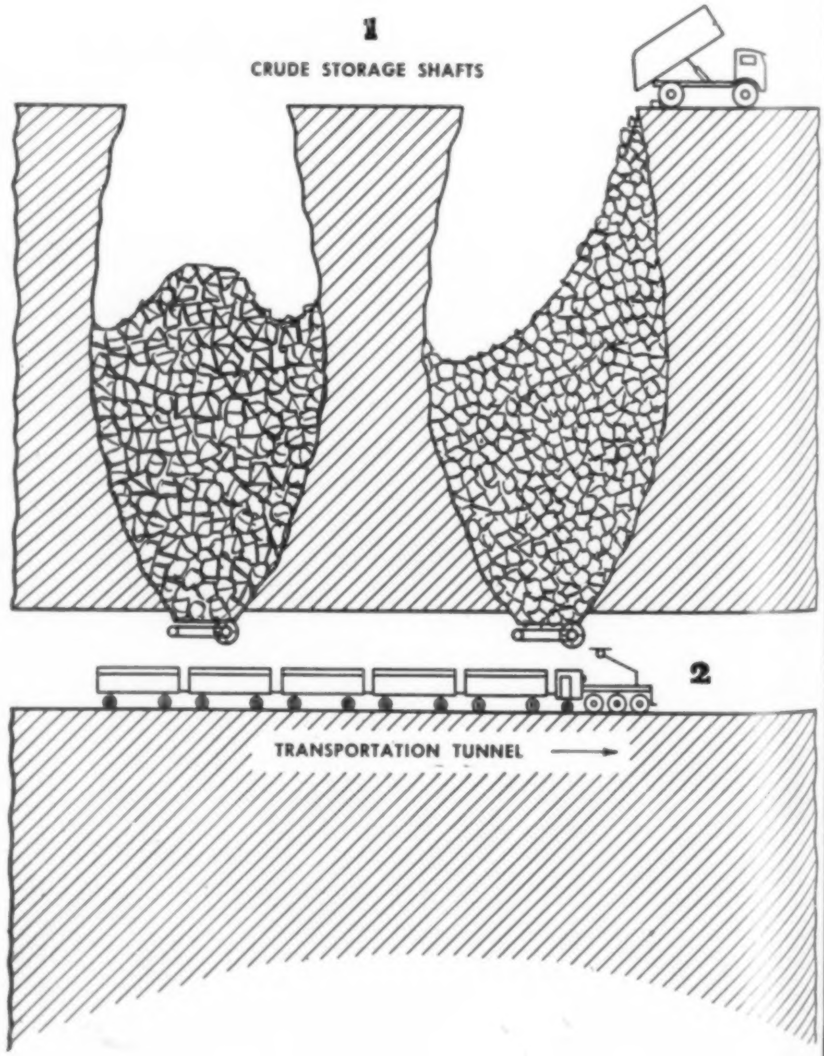
The crude, after preliminary crushing, is dried, milled, purified and classified simultaneously by a series of treatments with pneumatic blowers, separators and classifiers. Uncalcined, calcined and flux calcined powders are produced in a number of particle size ranges. Calcination is carried out principally in rotary kilns. Subse,uent steps are dispersing, conveying, seperating, classifying and packing. Much of the equipment is of special design adapted for diatomaceous silica.

CHEMICAL & METALLURGICAL ENGINEERING

August, 1942

PAGES 110-8 to 113-8

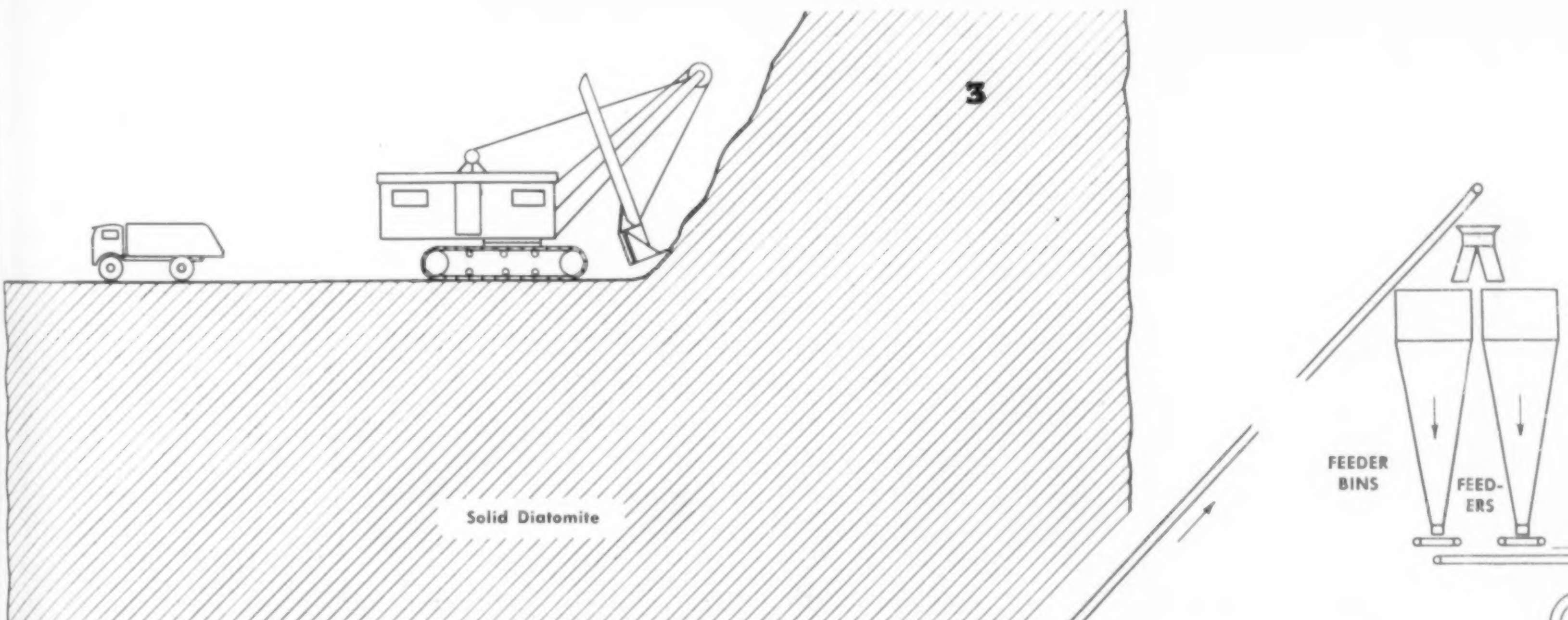
1 Crude diatomite unloaded into storage shaft for later delivery to mills. Some of these hold several thousand tons of material. Shaft is in solid diatomite



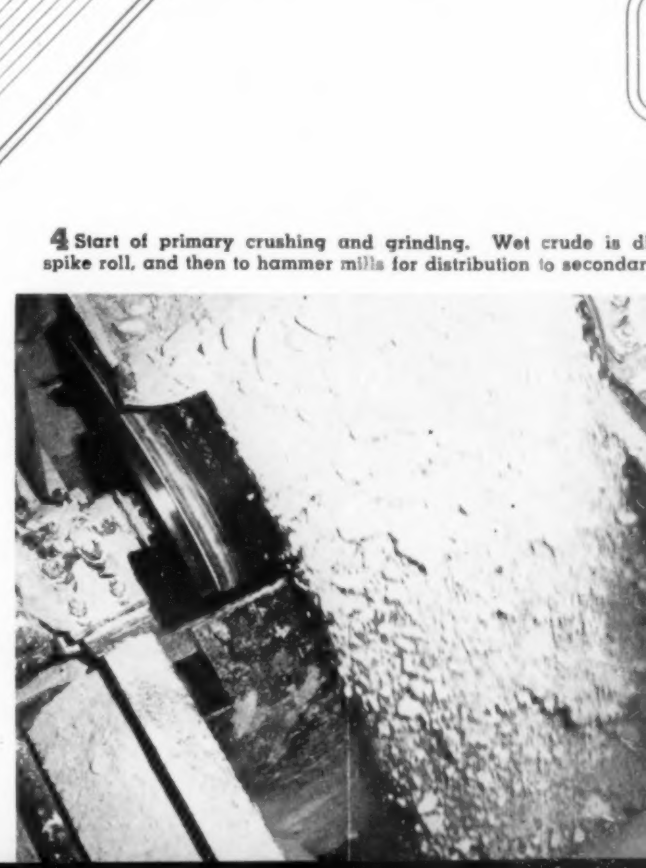
lls.
ite

2 Transportation of raw material from storage areas to the mill sites is by underground electrified trains operating in tunnels at mill elevation

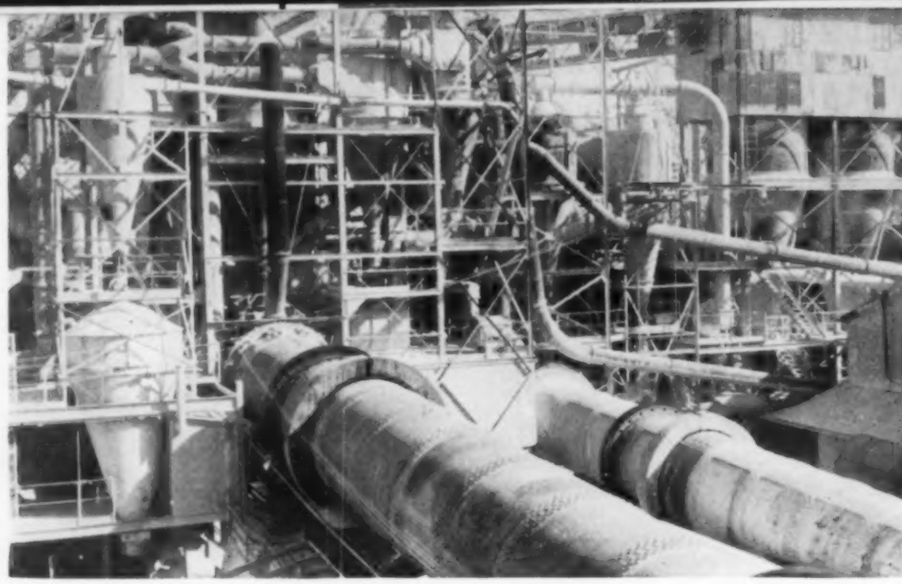
3 Two of the large open cut quarries in mountains of diatomite. Th
by drag line or power shovels and trucks. General topography is



4 Start of primary crushing and grinding. Wet crude is d
spike roll, and then to hammer mills for distribution to secondar

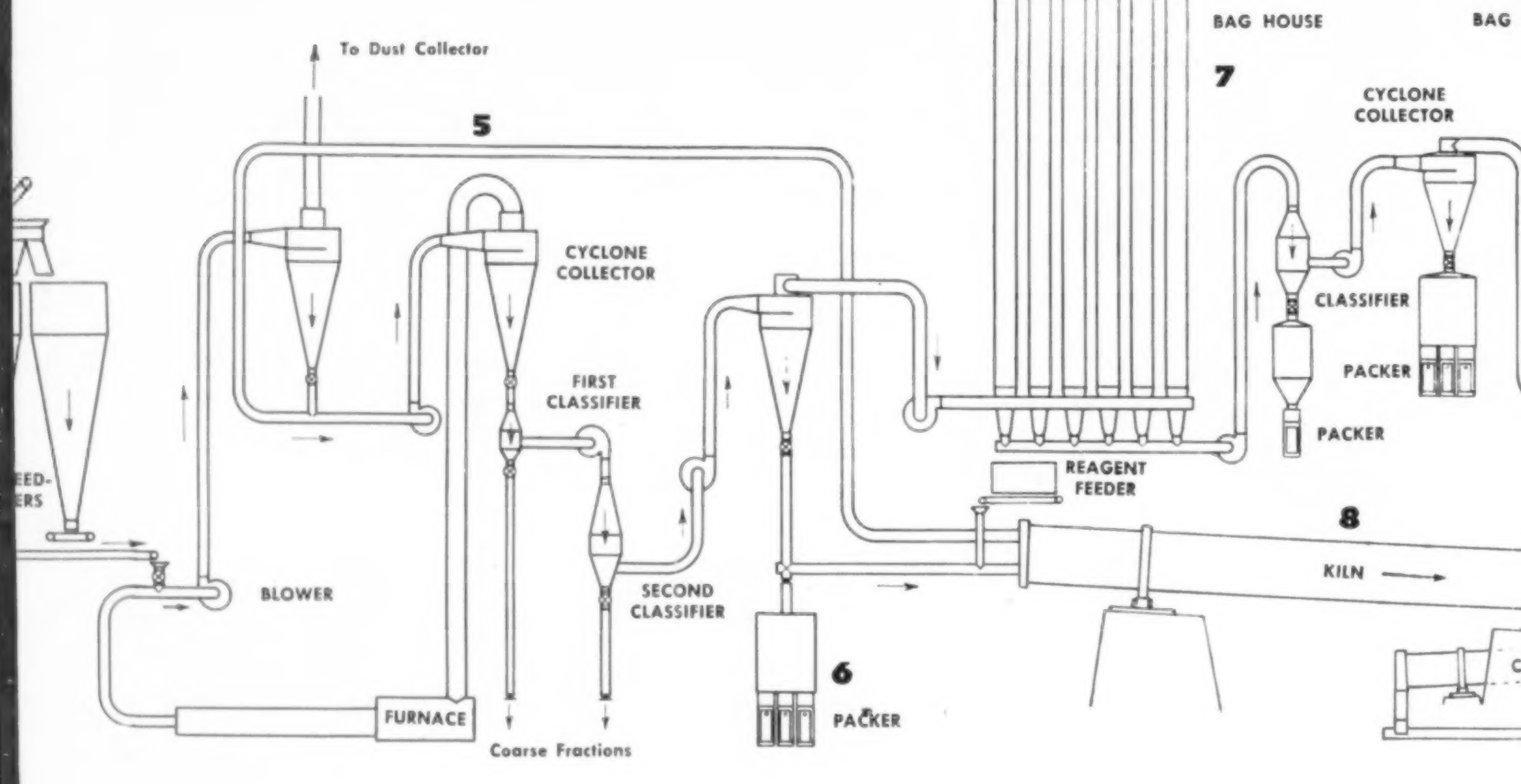


atomite. These are operated
ography is shown



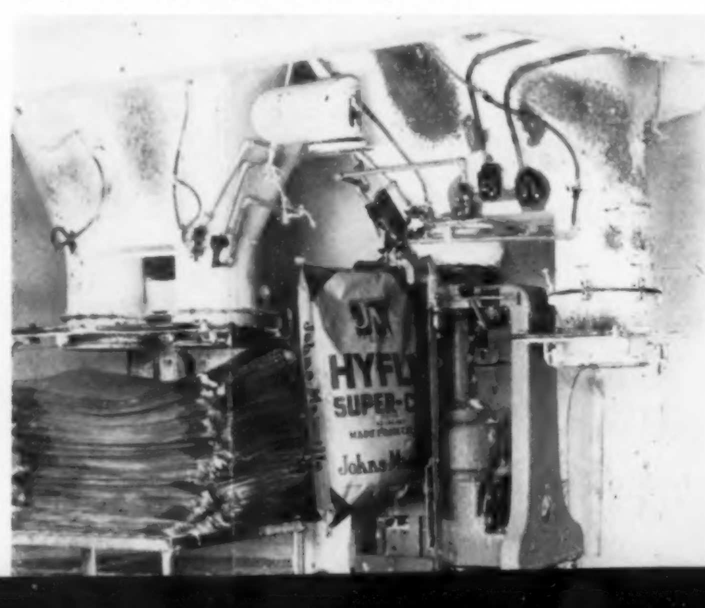
5 A portion of the filter aid mills, showing drying, milling, classifying and separating equipment. A large cliff of diatomite appears in the background

7 Stocking dust collect
fication of diatomaceou



crude is discharged from a belt into a
o secondary milling and processing units

6 Mechanical packers operating directly from packing bins are employed for the packaging of finished products

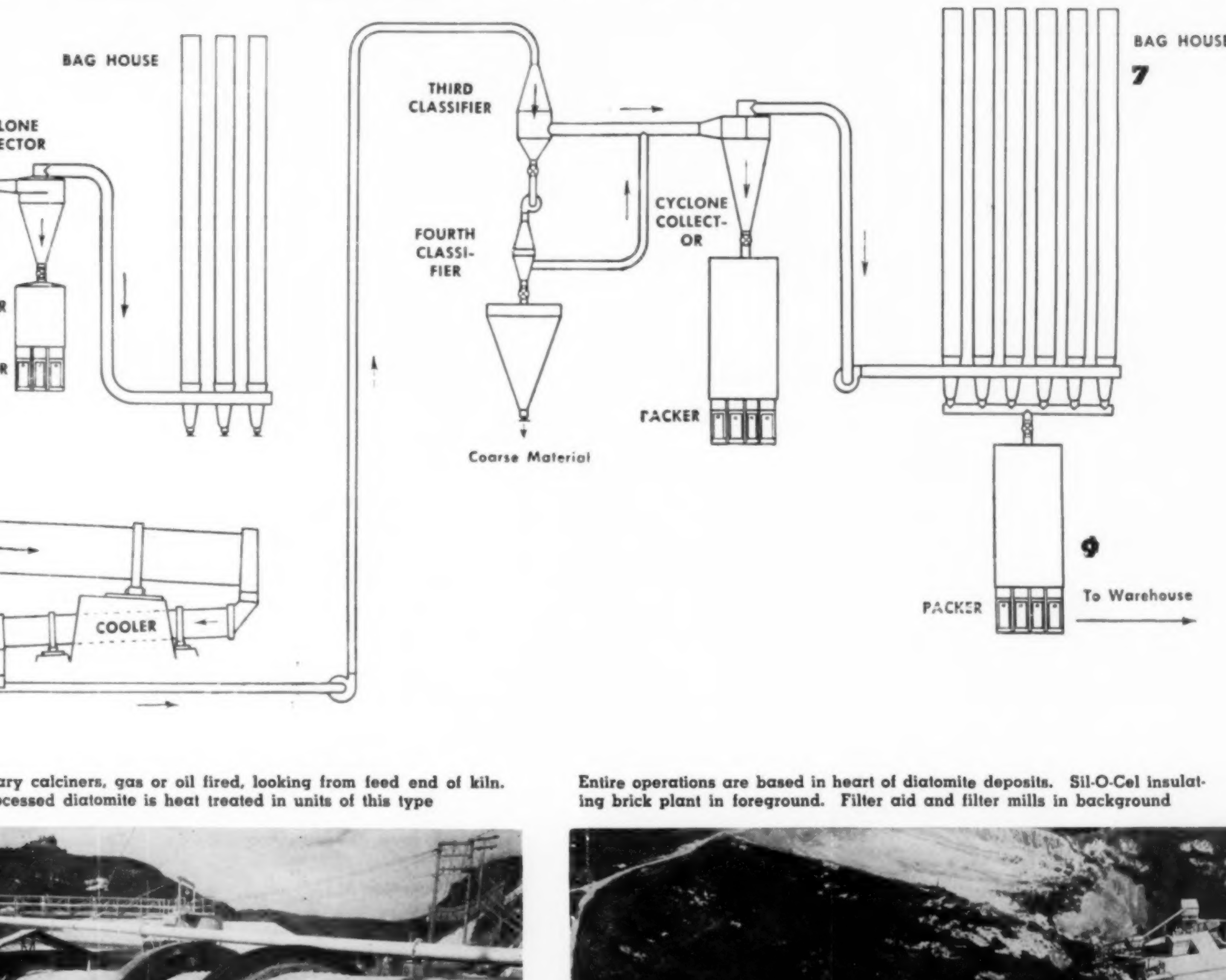


8 One of the rotary calciners,
Powdered and processed diato

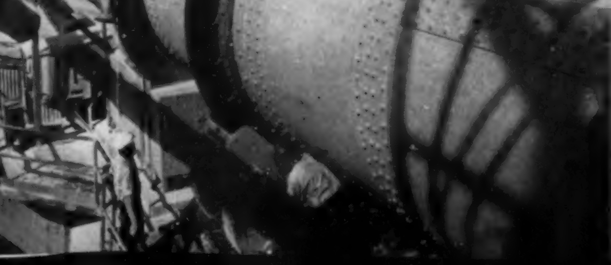
...g dust collectors aid in classi-
... diatomaceous powders

9 Warehousing showing lift truck and pallet methods. Products packed in 50 lb. paper bags for shipment

A
Chem & Met
FLOW
SHEET



...ary calciners, gas or oil fired, looking from feed end of kiln. ...ocessed diatomite is heat treated in units of this type

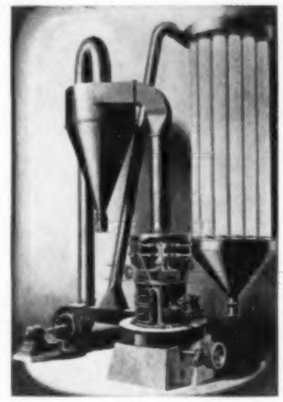


Entire operations are based in heart of diatomite deposits. Sil-O-Cel insulating brick plant in foreground. Filter aid and filter mills in background

Solve Your

PRODUCTION PROBLEMS

with **RAYMOND EQUIPMENT**



PIGMENTS . . .

INCLUDING
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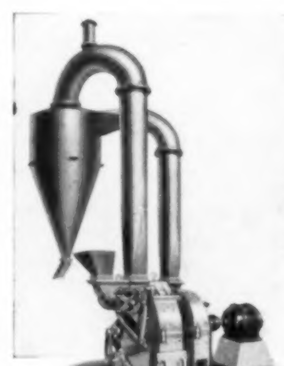
LITHOPONE,
TITANIUM
PIGMENTS

To bring out the desirable characteristics in grinding pigment materials .... such as *low oil absorption, high covering power, extreme fineness and uniformity* . . . use the Raymond whizzer-type Roller Mill. It pulverizes and classifies the product to any fineness up to 99.97% minus 325-mesh, producing a superior quality finished material. It is easy to regulate and it gives greatly increased capacities . . . 25% to 50% on harder materials, and up to 100% on softer materials.

INSECTICIDES . . .

INCLUDING
COPPER
SULPHATE,
SPRAY LIME
AND OTHER
CHEMICALS

In processing copper sulphate with the Raymond Imp Kiln Mill, the drying system of the mill can be controlled so as to remove exactly *four* of the five molecules of the *water of crystallization.* The material is pulverized to extreme fineness in the same operation. The resultant product is a mono-hydrated copper sulphate . . . a fine, dry, uniform powder, very economically produced. This is the standard method of manufacture so successfully used in many insecticide plants.



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MIXTURES,
DRIED MILK
POWDERS

The production of edible soya bean flour, both from the press cake and the solvent treated flakes, can be handled efficiently with the Raymond Imp Mill in combination with a Mechanical Air Separator, operating in closed circuit. The material is reduced in the mill and discharged to the separator, where it is classified to a fineness of 99.5% passing 300-mesh. The result is a fine commercial grade of soya bean flour, produced at low cost.

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CHEM & MET NEWS

GENERAL ANILINE WILL EXPAND RESEARCH ACTIVITIES

At a dinner in New York, held July 23, in celebration of the 100th anniversary of the founding by Edward Anthony of what is now Agfa-Ansco Division of the General Aniline and Film Corp., its president, Robert E. McConnell, announced plans for centralizing and greatly expanding the varied research operations of that corporation. A four-story building, formerly operated as one of the plants of the Stewart Silk Corp. in South Easton, Pa., has been leased and is being remodeled for use as a central research laboratory. A number of chemists, physicists and engineers are being transferred from operating plants of the company, principally at Grasselli, N. J. and Rensselaer, N. Y.

The direction of the research enterprises of General Aniline comes under Dr. William F. Zimmerli, formerly of du Pont and Dr. E. Clifford Williams, formerly of Shell Development, and more recently of General Mills.

Dr. Albert E. Marshall, vice-president of General Aniline and executive head of the Agfa-Ansco Division, announced a new process of color photography that will enable amateurs to develop color films in their home darkrooms. Thomas E. Brittingham of the Ozalid Products Division announced still another new product named "Ozaphane" which is a new sound-track film that will make it possible to play a phonograph continuously without the necessity of changing records or without the use of a needle. This new material will cost only about one-tenth of the silver sound-track film and will bring the recording of sound within the means of the average amateur photographer, according to Mr. Brittingham.

Due to its pre-war affiliation with the I. G. Farbenindustrie, control of the General Aniline & Film Corp. is now vested in Leo T. Crowley, alien property custodian.

CHICAGO CHEMICAL SHOW WILL BE HELD IN SHERMAN HOTEL

Changes in dates and location for the second National Chemical Exposition have been announced by the Chicago Section of the American Chemical Society under whose auspices the affair will be conducted. Originally scheduled to be held at the Stevens Hotel, Chicago, in the week beginning Nov. 17, the changes were made necessary because the facilities of the Stevens Hotel have been taken over by the U. S. Army. Under the new arrangement the Exposition will be held at the Sherman Hotel and the time has been moved back to the week beginning Nov. 24.

No changes are planned in the original program and there will be daily conferences to be addressed by leaders in the chemical industry, educators, and other outstanding authorities. The committee is arranging for an interesting display of motion pictures.

Victor Conquest, chairman of the show committee states that a preliminary survey indicates that more than 100 exhibitors can be accommodated which will give adequate space for exhibits about twice as large as the first exposition held in 1940.

COMMITTEE APPOINTED TO STUDY WAR MANPOWER PROBLEMS

Paul V. McNutt, Chairman of the War Manpower Commission, announced on July 30 that he had appointed a committee to formulate a coordinated plan for meeting the need of the Army, the Navy, and war industries for a continuing supply of engineers, chemists, physicists, and other scientific and professional personnel required in the war program.

Dr. Edward C. Elliott, President of Purdue University, and Chief of the Manpower Commission's Technical and Professional Training Division will serve as chairman of the committee. The other members are: James V. Forrestal, Under-Secretary of the Navy, Major General Lewis B. Hershey, Director of the Selective Service System, G. H. Dorr, Special Assistant to the Secretary of War, Arthur S. Flemming, member of the United States Civil Service Commission, and Wendell Lund, Director of the Labor Production Division of the War Production Board.

The committee is reviewing the various manpower problems relating to the utilization of college and university facilities and the plans suggested by various groups representing higher education to meet these problems. The committee will shortly make its recommendations to the War Manpower Commission with respect to the policy and action necessary to bring about the fullest possible use of the institutions of higher learning in the war program.

COMMERCIAL AGREEMENT WITH RUSSIA REVIEWED

The commercial agreement between the United States and the Union of Soviet Socialist Republics, which was proclaimed on and became effective Aug. 6, 1937 and which was renewed for successive periods of one year on Aug. 5, 1938, Aug. 2, 1939, Aug. 6, 1940, and Aug. 2, 1941, was continued in force by an exchange of identic notes at Washington on July 31, 1942 between the Secretary of State of the United States Cordell Hull, and the Ambassador of the Union of Soviet Socialist Republics, Maxim Litvinoff.

Although it is expected that in the coming year the character and amount of United States trade with the Soviet Union will be governed largely by the military requirements of the United States and the Soviet Union and other countries struggling against the forces of armed aggression, rather than by the usual commercial considerations, the exchange of notes will ensure the continuance during the emergency period of our established commercial relations with the Soviet Union.

Second in the weekly series of broadcasts on "The Engineer at War" was given over the N.B.C. network on July 23 by representatives of the American Institute of Chemical Engineers. Sidney D. Kirkpatrick, president, and Dr. Arthur B. Ray, chairman of the Institute's committee on civilian defense, spoke on "Protection against incendiaries and poison gas." Dr. Ray, who helped to develop the incendiary bomb used by our Army in the last war, is shown wearing one of the new Chemical Warfare Service training masks.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

Donald Nelson's "realignment" of the War Production Board in July marked a major turning point in the war effort—an end, by and large, of the tooling up and conversion phase of the job, and the beginning of the much more complex but relatively routine job of running the vast production machine which has been slapped together. The two phases overlap, of course, but the corner has been turned.

Separation of the policy and the operational units of the war agency is the principal recognition from an administrative standpoint of this evolution. The realignment was put into effect from the top down, in three stages, two of which were complete early in August. First of these was the revamping of WPB's "top side" by establishing two layers of policy determination—Nelson and William L. Batt (SKF Industries), aided by WPB's staff divisions to determine overall planning, and James S. Knowlson (Stewart-Warner), as WPB vice-chairman, to translate this "grand strategy" into operational programs—and a single administrative head, Director General for Operations Amory Houghton (Corning Glass), to direct administration of the program. Second step was the establishment of the Houghton and Knowlson administrative staffs.

Final stage is the regrouping of the 40-odd industry and commodity branches under Mr. Houghton which was still in process in the first part of August. This is expected to result in elevation of Dr. Ernest Reid's chemical branch to a division status with greater administrative authority within the pattern of the broad general policies dictated from "topside." Important fact for the chemical industry is that this realignment does not break existing industrial contacts with Washington. The change is administrative and evolutionary, but it is not a shakeup.

Alcohol Supplies

Production capacity for industrial alcohol has increased faster than demand, and the supply picture for this commodity today is brighter than at any time since the beginning of the war period. This situation is not expected, however, to last for long. While it is true, as Frazer Moffat, Jr., said upon retiring from the WPB chemicals branch alcohol section to don a uniform with Chemical Warfare Service, that more alcohol could be diverted to synthetic rubber next year than planned rubber plants can use, when these operations do get underway full speed there will be little surplus alcohol.

With this in mind, the chemicals branch early in August was readying a revision of Order M-69 to tighten up the controls of distribution of distilled spirits and high wines. A final deadline for cutting off entirely the production of alcoholic beverages within the next few months is in prospect.

Without waiting for the cut-off order, the beverage industry is making "rapid progress" in converting to industrial production. This was officially acknowledged in a statement from John B. Smiley, chief of the beverages and alcohol branch of WPB, who also pointed out that distillers are experimenting with stills made of wood and other non-critical materials.

At the same time, the Office of Defense Transportation issued a report that the transportation system established to provide a virtual assembly-line supply of alcohol to smokeless powder and rubber plants is operating efficiently. The program involves transporting blackstrap from Gulf ports and grain from the middle west to industrial alcohol plants in the east, high wines from whisky distilleries to rectifying plants and the finished product to war plants.

Rubber Program

Rubber continued to be the biggest headache for WPB and the nation throughout July. The fault can be shared by practically everybody, WPB, the President himself, the newspapers and the general public—it's a case where the wishes are father to the thought.

Biggest development from the chemical industry's point of view was WPB's effort to "freeze" the construction profram for the synthetic production goal which now is a plant capacity of 870,000 tons a year by 1944. Admittedly, this is, in effect, slamming the door in the face of progress; the decision rests upon the vital necessity of getting plants producing as quickly as possible by methods which are known to work.

Donald Nelson himself shouldered responsibility for this decision, in testimony before the Gillette committee. He acknowledged that the policy is contrary to the normal American competitive system but asserted that if construction plans were altered every time a new process is evolved no production ever would eventuate. Nelson said WPB would continue to study new processes — such as the Houdry development and the Department of Agriculture's regional laboratory experiments with butylene glycol (see elsewhere on these pages), adapt technological improvements to the program wherever this can be done without upsetting the production schedules.

Nelson's "squeeze" was subjected to an immediate test by the Congressional passage, with practically no hearings or serious floor consideration, of legislation establishing an independent government agency to build synthetic plants to make butadiene from alcohol. The farm bloc jammed the measure through both house but it was promptly vetoed by the President, who, at the same time named a committee to study the entire rubber situation. Bernard Baruch heads this committee with Dr. James B. Conant, president of Harvard University and Dr. Karl T. Compton, president of Massachusetts Institute of Technology as the other members.

At this stage of the proceedings, the government rubber program called for plants to turn out 700,000 tons of Buna S, 40,000 tons of Neoprene, 130,000 tons of butyl and Thiokol. Of the Buna S, 500,000 tons will come from a petroleum-base butadiene, 200,000 tons from an alcohol-base raw material. Only change in this lineup during the month was the expansion of the butyl program by 70,000 tons, largely on the finding that additional output could be obtained from the same plant and that some additional plant could be erected without new critical materials.

On the rubber consumption "front," at the level of tires for private transportation, the situation continues to boil. During July, at the request of WPB Rubber Coordinator Arthur B. Newhall, the rubber manufacturers association developed a program which could make available about 50 million 10,000-mile recap and butyl tires for civilian driving in the next 24 months —IF the Government could divert approximately 200,000 tons of reclaim, 3,000 tons of crude, 30,000 tons of butyl and an equal amount of thiokol. This number of tires was estimated to be sufficient to keep most cars rolling for the next two years—IF drivers would reduce overall mileage 40 percent, reduce all speeds to less than 40 m.p.h. and keep their tires carefully serviced. WPB's first reaction was that even the relatively small amount of rubber required couldn't be diverted to tires in the face of the Army's complete elimination of rubber treads for tanks because their simply isn't enough rubber to go around.

Fertilizer Chemicals

During the early part of July Dr. E. W. Reid, Chief of the Chemical Branch, requested that no mixed fertilizers containing chemical nitrogen be sold for use on fall-sown grains. This request was quite logical since the use of fertilizer for that purpose does not result in any appreciable improvement in the yield and the nation already has more wheat than it knows what to do with.

In general the reduction in the nitrogen content of fertilizers has resulted in the addition of other elements where such addition is justified. The very obvious object of these moves is to put nitrogen only where it is most needed in the war effort. Along with the curtailments just noted there has been no allotment to industry of ammonia in solution. The allotment of ammonium sulphate however has taken place in conformity with the regulations laid down by the department of agriculture, based primarily on past usage.

There is no shortage at present in either potash or phosphate. The potash supply is large enough to meet all chemical and agricultural needs. At the present time the capacity for the manufacture of superphosphate is practically double the amount produced in any previous year, apparently assuring an ample supply for all purposes. A list of the specified grades of fertilizer to be sold in the various states throughout the country is being prepared for distribution to the industry shortly.

Transportation Bottlenecks

It appears that rail transportation is becoming the bottleneck for some chemicals. Potash and sulphur which always have been shipped by water from southern ports to the north Atlantic seaboard are now moved entirely by rail. An effort has been made to build up inventories before cold weather and the strain of moving an unprecedented quantity of coal and munitions tie up the railroads. Ceilings on inventories of sulphur and phosphate have been removed to enable the industry to accumulate stockpiles to carry over an emergency period. Shipping is also the bottleneck limiting the supply of another chemical, Chilean sodium nitrate. Lack of shipping space and sinkings make the supply from that source uncertain. Between 600,000 to 7000,000 tons of sodium nitrate were imported during the last fertilizer year. This will help relieve some of the shortage occasioned by diversion of other nitrogen containing products, such as calcium cyanamid and synthetic ammonia, from fertilizer to war uses. Since essential military and industrial needs must be satisfied first, agriculture will have to get along on what is left.

But this not too unpleasant picture may be short lived. Unless the rate of importation can be increased so that the Government and industry as well can build up an emergency stockpile before the end of the calendar year the shortage will be acute in the spring of 1943 when the demand for fertilizer reaches its height. Government estimates vary as to the total nitrogen deficit but it is generally agreed that the pinch will come in 1943. It is also agreed that in 1944 the supply will improve as new synthetic production facilities come into operation.

It has been estimated privately that the fertilizer industry will need 450,000 tons of nitrogen from inorganic sources for the July 1, 1942-June 30, 1943, year if the needs of agriculture are to be served adequately. Assuming that 250,000 tons of nitrogen can be obtained from domestic sources (an optimistic figure), then 200,000 tons of nitrogen for agriculture alone must be supplied by the importation of sodium nitrate. In terms of ships and tonnage that quantity would require the movement of 1,200,000 tons of nitrate or 120 shiploads if handled in our largest cargo carriers.

The Chilean production is still far below capacity. It is probable that in 1941 production reached 1,250,000 to 1,500,000 tons, but this figure is capable of considerable expansion say to 4,000,000 tons since the additional production would not require much more than double shifting at the mines.

It has been reported that the Chilean Navy (mostly training ships) is transporting nitrate to supply Latin-American countries, especially Brazil. Direct shipments of sodium nitrate from Chile to other Latin-American countries is being made wherever possible to relieve the United States from exporting ammonium sulphate, since these products are practically interchangeable as nitrogen-bearing fertilizers. Before World War No. 1 natural sodium nitrate was used almost exclusively to make nitric acid. In the intervening years the process has become obsolete, being superceded by a synthetic ammonia oxidation process. However, nitric acid is again being made in increasing quantities from natural sodium nitrate by the old method.

Larger Chlorine Output

Just as the orders limiting the inventories of sugar damming the normal flow from refiner to consumer have caused that commodity to break out of the distribution channels at the oddest points the effort to increase production of some commodities have resulted in equally queer things in the chemical field. For instance, new production has come in and the supply and demand for chlorine are nearly in balance. In fact, chlorine can be said to be in reasonably good supply at the moment. However this has not resulted in even the slightest hint that the restrictions on the use of chlorine will be relaxed and there is nothing in the picture to indicate such action in the future.

The additional chlorine production by the electrolysis of brine has left in its wake a problem. Caustic soda, the other product of the reaction, is rapidly becoming a disposition problem. The same is true of spent sulphuric acid but to a lesser degree. Demand for sulphuric acid for pickling steel has declined with the increase in the production in steel plates. A given weight of steel rolled into sheets one-sixteenth of an inch thick has fifteen times as much surface from which the scale must be removed as the same weight of steel rolled into a plate one inch thick. So, as the production of steel plates increases the supply of sulphuric acid improves.

Metal Priorities

Chemical plants using \$5000 or more worth of metals in any of several score forms listed on the WPB Metals Control List No. 1, Revised, will probably be operating under the Production Requirements Plan priority machinery for the fourth quarter of this year, it appeared in early August.

This means a transfer from the procedures of Order P-89 for repair and maintenance and operating supplies to the priority mechanism which was made mandatory for most manufacturing concerns for the current quarterly period. Primarily, this means advance application on PD-25A forms for all the critical materials which will be needed in the forthcoming quarterly period, instead of operation under P-89 for repair and maintenance and a dozen other varieties of priorities procedures for obtaining raw materials to feed production lines.

PRP, originally an enlargement of the old Defense Supplies Rating Plan, has been re-tailored to provide the war agency with a strict control over acquisition and use of critical metals and other materials as a big step toward outright allocation of all raw materials. Gist of the scheme is that WPB obtains, on a PD-25A forms, advance applications from virtually all industry—military and civilian alike—for the raw materials to be used both in production and in maintenance during each forthcoming quarter. These are totaled and stacked alongside the available supply, after which a percentage allocation is made to each industry by the Requirements Committee ranging, potentially, from 100 to zero, based upon the relative urgency of the industry's operations and the relative deficit in supply to requirements.

Priority certificates then are issued to individual companies authorizing acquisition on assigned ratings of their share of the overall industry allocation. Acceptance of deliveries beyond the total authorized, whether on ratings or not, is prohibited. Thus, if the mathematics are correct, there is enough raw materials to supply the authorizations which are distributed. In addition, WPB thus gains full control over distribution of scarce materials, can apply or release the brakes on any type of production from time to time as the shifting fortunes of war dictate.

Butylene Glycol

A new short-cut and economical method for making butylene glycol by fermentation of farm crops such as corn and wheat was announced formally in July by the Department of Agriculture and the Office of War Information. The process is in pilot plant stage at the Northern Regional Research Laboratory at Peoria, Ill., and commercial development is planned.

The laboratory is now studying the possibility of using butylene glycol as a raw material for conversion into butadiene for the manufacture of synthetic rubber. This phase of the experimental work is being closely watched by the War Production Board as having potential value in getting increased supply of one of the two major raw materials for Buna S. To date, chemists at work at the laboratory have announced excellent yields of pure butadiene from corn-base butylene glycol in experimental quantities, but the operation has not developed beyond the pilot plant stage.

REFEREE BOARD APPOINTED TO ADVISE WPB ON COMPETING CHEMICAL PROCESSES

Recognition of the increasing importance of the chemical contribution to the war effort is seen in a recent change of WPB's Chemicals Branch to the status of a major division. Simultaneously it was announced on July 19 by Division Chief, Dr. Ernest W. Reid, that a committee of 12 American chemists and chemical engineers had been appointed to advise WPB on various chemical processes. The work of the Referee Board, Dr. Reid said, will be to pass upon the relative merits of competing chemical processes involved in the war program. The basis upon which their findings will be made will be (a) which process can be placed in production soonest and (b) which uses the smallest amount of critical materials.

Dr. Reid explained that the need for the services of this group of consultants arises from the fact that it is often difficult under the present war economy to obtain unbiased factual testimony as to which of a number of proposed chemical processes is the best to pursue. Each new process has its adherents and in most instances each has its good points. The Referee Board will be asked to evaluate such processes in the light of the war program and will recommend the adoption of one or another procedure.

The Referee Board of the Chemicals Division of the War Production Board is headed by Dr. Donald B. Keyes, head consultant to the Chemical Division, and professor of chemical engineering at the University of Illinois. Six of its members, including Dr. Keyes, are connected with the chemistry and/or chemical engineering departments of American universities. The other six members are drawn from industry, chiefly consulting chemists and chemical engineers, representing no single industry, client or employer. The various geographical divisions of the country are represented in the board membership which includes three past-presidents of the American Chemical Society, four councillors and two directors, as well as the present president of the American Institute of Chemical Engineers, a director and four former members of its council.

Membership of the Referee Board of the Chemical Division consists of Dr. Donald B. Keyes, chairman and head consultant to the Chemical Division, WPB, Dr. Marston T. Bogert, Belgrade Lakes, Me., emeritus professor of organic chemistry, Columbia University; Charles O. Brown, consulting chemical engineer, New York City; Dr. Charles R. Downs, vice-president, Weiss and Downs, Inc., New York City; Dr. Gustavus J. Esselen, president, Gustavus J. Esselen, Inc., Boston, Mass.; Dr. Joel H. Hildebrand, dean, College of Chemistry, University of California, Berkeley, Calif.; Sidney D. Kirkpatrick, editor, *Chemical & Metallurgical Engineering*, New York City; Dr. S. C. Lind, dean, Institute of Technology, University of Minnesota, Minneapolis, Minn.; Carl S. Miner, director, Miner Laboratories, Chicago, Ill.; Dr. Fred H. Rhodes, director, School of Chemical Engineering, Cornell University, Ithaca, N. Y.; Dr. Foster D. Snell, president, Foster D. Snell, Inc., Brooklyn, N. Y.; and Dr. Frank C. Whitmore, dean, School of Chemistry and Physics, Pennsylvania State College, State College, Pa. Serving as secretary of the committee for its first meeting held at the Cosmos Club in Washington, July 20, was C. O. Munster, formerly of the research department of the Imperial Oil, Ltd. of Sarnia, Ont.

The Chemicals Division of WPB which now numbers more than 500 employees, is expected to absorb several of the smaller branches as the general regrouping plan is put into effect in the WPB organization. These divisions report to Amory Houghton, Director-General of Industry Operations, through A. I. Henderson, who has previously been the director of the Materials Division. Now as deputy Director-General for Industry Operations, Mr. Henderson is in charge of all the former industry and commodity branches of the Materials and Industry Operations Divisions.

HERCULES POWDER PUTS RESEARCH WORK ON WARTIME BASIS

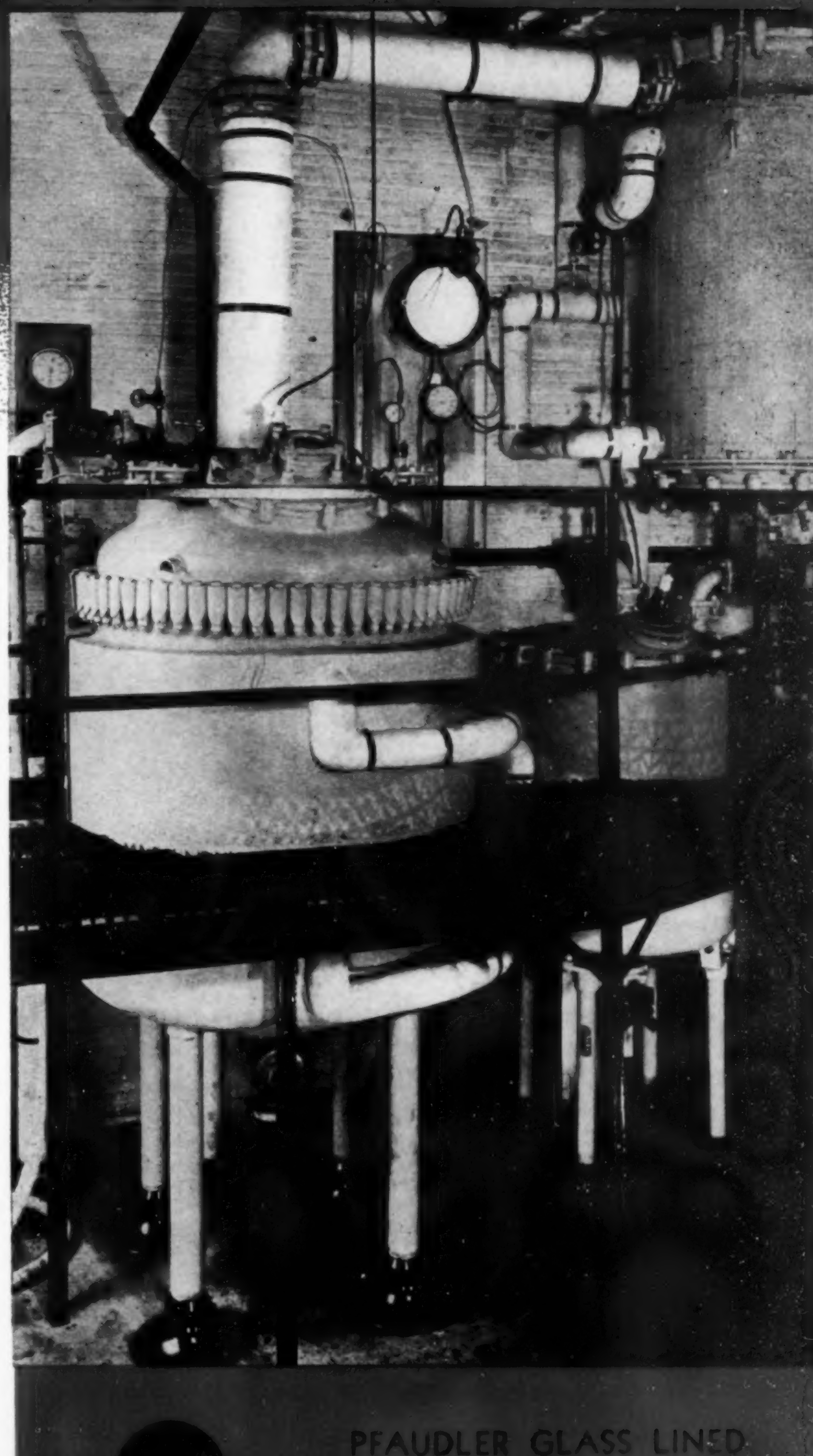
Dr. Emil Ott, director of research for the Hercules Powder Co., announces that research activities at the company's central experiment station laboratories have been placed on a wartime basis. This includes the establishment of a night shift and the taking on of qualified women workers to take the place of men chemists who have been transferred to ordnance work. There are more than 200 trained chemists and a total research staff of more than 600 now employed in the 15 buildings located on a 300-acre plot on the outskirts of Wilmington.

CHICAGO SECTION OF A.C.S. MOVES HEADQUARTERS

The Chicago Section of the American Chemical Society has moved its headquarters to the Medinah Club, 505 N. Michigan Avenue, Chicago, as of August 1. This move was made necessary by the fact that the United States Army has requisitioned the Stevens Hotel for the lodging and training of army and air force technicians. The Stevens has been the headquarters of the section for many years.

Keyes Bogert Hildebrand Lind Rhodes Whitmore

Brown Downs Esselen Kirkpatrick Miner Snell



LIMITED SUPPLY OF FERTILIZERS AND INSECTICIDES POINT TO CROP SHORTAGES IN EUROPE

Special Correspondence

EDITOR'S NOTE: *Cut off from direct correspondence with all except a few foreign sources in neutral countries, these notes interpret recent developments in continental Europe as reported in publications and official documents received in the United States. These monthly letters, prepared in this country, will be continued only so long as pertinent material of interest to American chemical industry is available for our comment and interpretation.*

CROP shortages in continental Europe will be aggravated this year by serious deficiencies in the supply of fertilizers and insecticides. Even in normal times, depleted western European soils are heavily dependent upon intensive use of fertilizers. Most countries are deficient in nitrates for agricultural purposes since they have been diverted to war production.

Because of its large synthetic nitrate capacity, Germany is relatively better supplied with nitrogenous fertilizers than are other European countries. Nitrogen quotas, as announced recently, will be equivalent to 76 percent of the 1938-39 crop year. Potash supplies, augmented by Alsatian production, will be 100 percent as compared with the above pre-war period. Superphosphates, however, will be very short, equaling only 33 percent of 1938-39 supplies. Normally the Reich imports large quantities of phosphate rock from the United States, Russia, and northern Africa. At present some imports of phosphate rock are being obtained from Tunisia, but other heavy demands on sulphuric acid needed for superphosphate production contribute further to cut the supply of this material.

One of the greatest difficulties European farmers face is the damage to their crops from plant diseases and insect pests. This will be aggravated because of current shortages of the necessary chemicals for insecticides resulting from the cessation of overseas imports and from diversion of chemicals normally used for these purposes to uses more directly connected with the war.

In all European vineyard areas, one of the most acute shortages is in copper sulphate, badly needed for spraying. Various new products are being tried but apparently with no great success. Spain is attempting to recover larger amounts of both arsenic and copper, contained in small amounts in Spanish pyrites, by prohibiting exports of pyrites unless the copper has been previously removed.

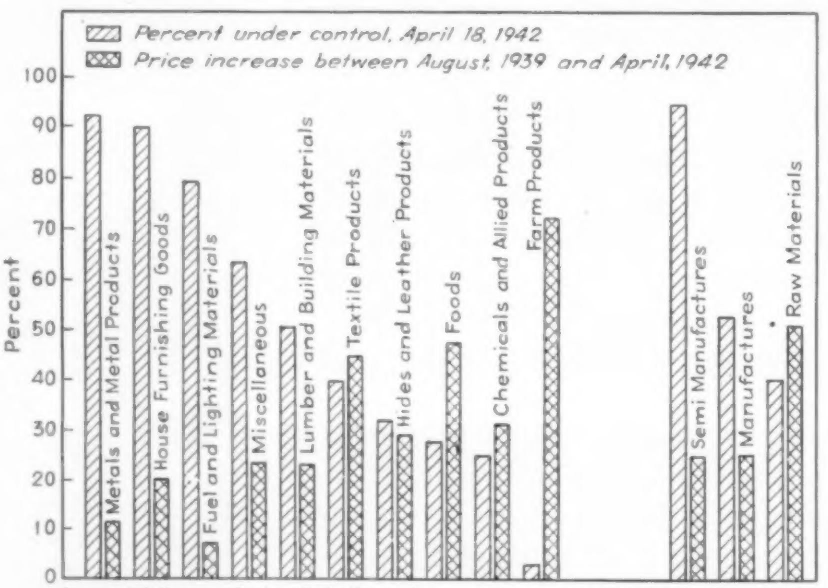
In France the supplies of insecticides and fungicides in 1941 were sufficient to meet only one-half requirements. In April 1942, for instance, only 40,000 tons of copper sulphate were available to meet normal needs of 100,000 tons. Copper utensils and all possible scrap copper are being requisitioned, partly to be made into copper sulphate needed to protect the grape crop. Present fertilizer supplies available in France are estimated to be equivalent to only 50 percent of the usual requirements for potash, 33 percent for phosphates, and 33 percent for nitrates.

In Italy, distribution of nitrates for agriculture declined from 153,000 metric tons in 1940 to 131,000 tons in 1941, and phosphates from 316,000 to 278,000 tons. Italian fertilizer consumption has been cut considerably this year, especially because of shortages of power, coal, transport, and raw materials. Electrochemical industries have made Italy able to supplant substitute synthetic nitrogenous fertilizers for formerly imported Chilean nitrates. The lack of rainfall in Italy last year, however, cut down the power supply, and accordingly, the output of synthetic nitrates. Montecatini, Italy's metallurgical and chemical combine, which normally consumes one-tenth the country's total electric current production, is reported to have shut down one 20,000-ton capacity nitrate plant because of a shortage of coal. No fertilizers were allotted this year in Italy for sugar beets, chicory, and other root crops. Suffering from the same shortage of copper sulphate as other countries, Italy has turned to the preparation of new spray formulas requiring a smaller use of copper. Two antiphylloxera products are reported to be made from citric acid, and Montecatini expects soon to manufacture entirely copper-free insecticides for vineyards.

Montecatini Report

In its latest annual report, Montecatini, the Italian counterpart of Germany's I. G. Farben, announces that it is now operating 225 plants, 58 of which are manufacturing phosphatic fertilizers. Italy is especially short of phosphates since it has been unable to obtain supplies from the United States, Morocco, Tunis, and Egypt. The huge concern is operating 8 nitrogen plants and about 30 mines producing pyrites, sulphur, copper, zinc, lead, bauxite, fluorite, barytes, marble, and lignite. About 24 plants are engaged in refining and processing the output of the company's numerous mines. Montecatini is planning to produce cobalt and manganese ores and is constructing a new aluminum factory. Italian production of alumina from bauxite is reported to be sufficient to meet domestic needs and provide for small exports. Machinery for new plants has been imported from Germany.

In Montecatini's report for 1941, it is stated that most of the 25 factories engaged in the manufacture of industrial chemicals have changed over to war production. The aniline dyes factory, in which I. G. Farben has a 41 percent interest, is reported to have increased its production, mostly of cheaper grades of dyestuffs. Only meager details are given on the concern's 25 paint, lacquer, and explosives factories, 8 glue and adhesive works, and 3 plastics plants. Montecatini has increased its capitalization again from 1600 million lire to 2000 million

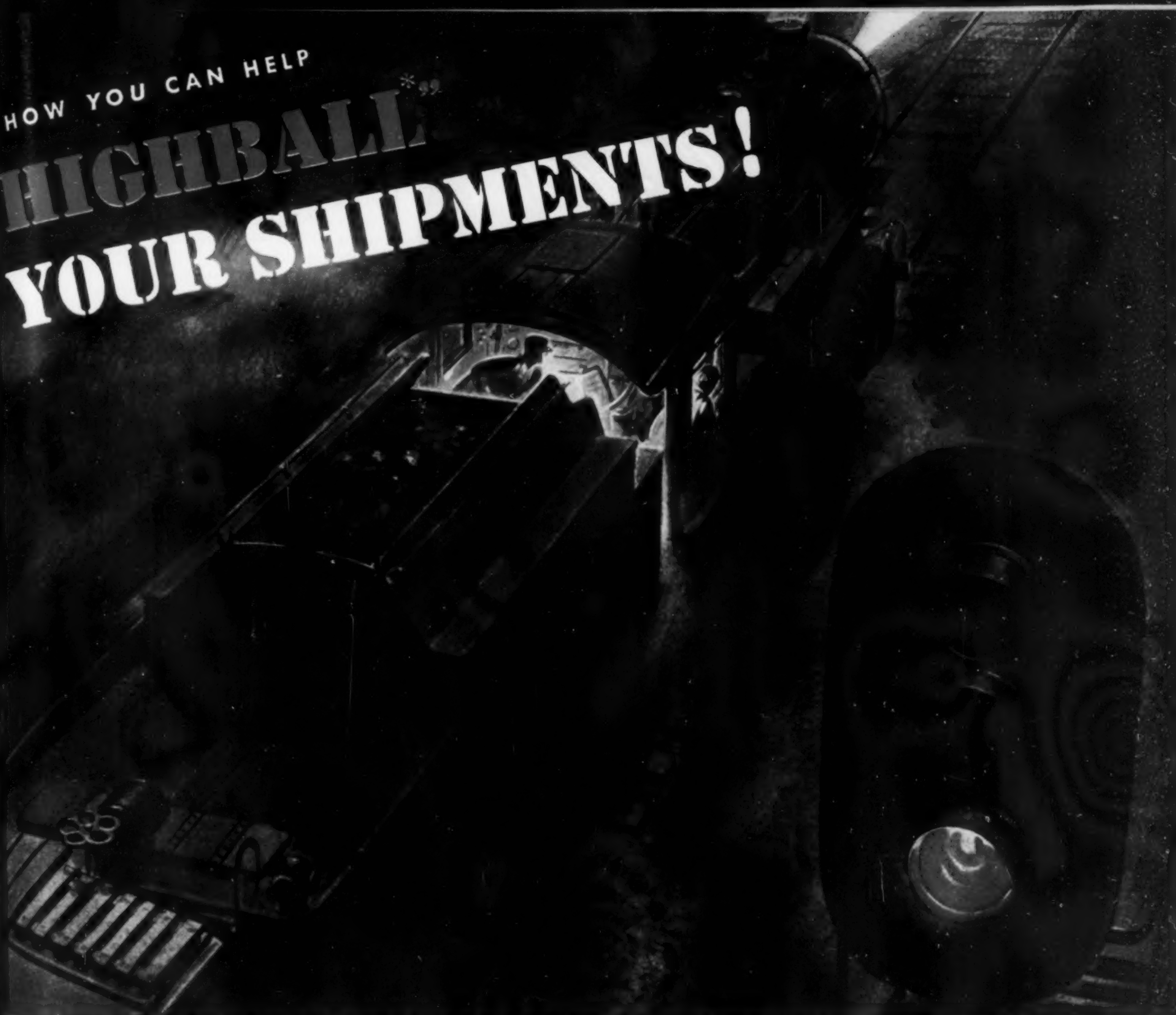


Source: U.S. Bureau of Labor Statistics and Office of Price Administration

Office of Price Administration Division of Research

Relationship Between Price Increases and Extent of Government Control

OPA controls over prices for commodities have varied according to the extent of the controls within the individual commodity groups. Farm products, only three percent under control, had risen 71 percent in the 33 month period ended April 1942. Chemicals, 25 percent controlled, had advanced in price but 31 percent in the same period as government regulations were aided by voluntary stabilization on the part of producers.



*A FAST, THROUGH SHIPMENT IN RAILROAD TERMINOLOGY

Customers of General Chemical Company can speed the delivery of their own orders and aid the Victory Program by remembering these two important points when placing orders:

❶ **ORDER "MAXIMUM" RATHER THAN "MINIMUM" FREIGHT CARS:** By ordering maximum cars, you order less often. By ordering *less often,* you immediately release many tank and box cars which are urgently needed for the shipment of war essentials.

❷ **CONSOLIDATE YOUR ORDERS:** Instead of ordering certain items one day, and others at a later time, these orders should be *combined* into *one large order.* This procedure will reduce the number of requisitions to be handled, avoid *additional* deliveries where one would serve, and, in the case of truck deliveries, conserve supplies of gasoline and badly needed rubber.

• • • •

Remember these important requests *each time* you order and you will facilitate the handling and delivery of your own orders . . . *and at the same time directly aid the Victory Program* by expediting the shipment of other vitally needed war materials!

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lire, and declared a dividend of 10 percent, based on a rise in net profits from 160 million to 175 million lire, as compared with the previous year.

I. G. Farben, which has recently raised its own capital by another 100 million RM to 848.5 million RM, is using 48.5 million RM to finance its share of "Francolor," the recently formed Franco-German dye trust. I. G. Farben, according to "Chemische Industrie," is supplying a nitrate factory with a 23,000 ton annual capacity to Spain. The plant is being installed for Altos Hornos de Biscaya, largest iron smelting company in Spain, and according to earlier announcements, should be in production by 1943. Plans provide a capacity of 115,000 tons of ammonium sulphate a year, equivalent to 30 percent of Spain's pre-war consumption of this important nitrogenous fertilizer.

A vital part in German military production is being played by the Köln-Rottweil section of the I. G. concern Köln-Rottweil recently celebrated its 50th anniversary and now comprises Dynamit A. G., formerly Nobel, and Westfaelisch-Anhaltische Sprengstoff A. G., also under I. G. In World War I Köln-Rottweil supplied 75 percent of the total German powder production. In post-war years the Premnitz plant of this concern was converted to the manufacture of staple fiber, while the Dueneberg plant turned to the manufacture of Vulcan fiber board, and floor and table coverings, as well as staple fiber.

Cologne is the center of a number of important powder and explosives plants operated by I. G. subsidiaries. That a shift to less vulnerable areas in eastern Germany is contemplated might be deduced from a recent unusual increase in capitalization of the only important Upper Silesian explosives manufacturer. The capital of Sprengstoffwerke Oberschlesien G.m.b.H. has been raised suddenly from 500,000 RM to 6,000,000 RM.

Air Raid Effects

The effect of British air attacks, particularly in the Ruhr industrial areas, is reflected in a report from Berlin that the German Government has ordered the reorganization of the entire iron industry of the Reich under a unified control body, called the "Reichsvereinigung Eisen." One of the functions of the new organization will be to facilitate the quick switching over of orders from bombed works to undamaged factories.

In German air raids on Britain, duds of bombs dropped by German planes are found to equipped with plastic fins using asbestos as a filler material. The plastic bomb fins have withstood temperatures up to 1,000 deg. F. in tests. Industrially, asbestos cloth is of course being used in making laminated plastic gears which show high heat and wearing resistance. Germany is also using large quantities of plastics to make gun-stocks in which wood flour rather than mineral fillers

is being used. Straw is also reportedly being used extensively in the Reich as a filler for plastics.

To save coal-tar needed for war industries, the Germans have been experimenting for some time to find a satisfactory material for binding coal and lignite briquettes, which are much more widely used for household and industrial heating in Germany than in the United States. It is claimed that satisfactory results have been obtained by stretching coal-tar with 50 percent artificial resins or sulphite waste liquors. Some success is also reported in pressing briquettes without the use of any binding substance at all. The Zellstoff-fabrik Waldhof, one of the largest German cellulose concerns, claims that it has obtained promising results using sulphite lye as a binding substance for fuel and briquettes. Interest in such a process is heightened by the difficulties which cellulose plants are experiencing in disposing of their mounting quantities of waste products.

The cell wool industry, which now supplies 60 percent of Germany's textile fibers, is one of the largest consumers of heavy chemicals. At the rate of production early in 1940, to produce 300,000 metric tons of synthetic fibers, both staple and rayon, the industry required 360,000 tons of woodpulp, 375,000 tons of caustic soda, 108,000 tons of carbon disulphide, and 465,000 tons of sulphuric acid. Current production of cell wool alone is said to require an annual consumption of 400,000 tons of sulphuric acid, and 360,000 tons of caustic soda in Germany. New recovery processes are being instituted. The waste Glauber's salts, of which about 300,000 tons are obtained in the spinning baths of German cell wool factories alone, is to be subjected to electrolytic decomposition to yield sulphuric acid and caustic soda. It is claimed that a new economic process can recover these two products in fairly satisfactory amounts and grades. Efforts are also being made to recover some of the 140,000 tons of carbon disulphide now being used annually in the German cell wool industry. By drawing off the carbon disulphide escaping from the spinning bath as well as by steam distilling carbon disulphide still adhering to cell wool, it is now claimed that 40 percent of the carbon disulphide can be recovered. This would be equivalent to a saving of 60,000 tons per year of sulphur, much of which Germany has to import.

I. G. has patented (D.R.P. 699,961) an improvement in the process for recovering copper from waste waters in the rayon industry. Under the process, the alkaline solution of the precipitating bath and an acid decoppering liquid are mixed in such proportions as to give a pH 6-8, generally 6.5-7.5. The mixture is immediately passed through a sand filter and the copper is recovered in the form of $Cu(OH)_2$ from the sand for reuse in the usual way.

CENTRAL COMMITTEE OF EXPORT GROUPS APPOINTED TO RESTORE BRITISH CHEMICAL EXPORTS

Special Correspondence

First official step towards the restoration of the British chemical industries' export trade after the war was taken a few weeks ago when the Board of Trade appointed a Central Committee of Export Groups. Of the committee's five members four are specialists in the perfumery, plastics, pharmaceutical, and general chemical trade. They are thus in the best position to advise the Board of Trade and the Export Council on questions of chemical exports. At present the committee's task can be only the collection of statistical and other information. The range of wartime exports has been drastically reduced by shortages, licenses and shipping difficulties. Smaller firms have in many cases given up exports for the duration of the war even when theoretically possible because the small turnover does not justify the additional expense.

On the other hand, Imperial Chemical Industries Ltd., the leading British chemical combine, expressed satisfaction "at the degree in which the volume of exports has been maintained" in 1941. The company's success in holding a substantial overseas market was attributed to "the willing assistance afforded us in maintaining supplies for our normal export markets by goods manufactured and shipped on our behalf by our manufacturing subsidiary or associated companies in the British Empire as well as by the same kind of help given us by our American friends, notably E. I. du Pont de Nemours & Co." Smaller British firms were not in a position to make similar arrangements for the maintenance of their export trade, and I. C. I. will also have to tell a different story for the current year.

In the British home market most of the month's news is again about the utilization of indigenous materials for new purposes. Wool fat is now employed for making different sorts of grease. Railway axle box grease can be mixed from 15 parts of a specially made crude wool grease soap ribbon, 2½ parts of 40 percent caustic soda solution, 25 parts of recovered wool grease, 10 parts of cheap spindle oil and 47½ parts of water. A new oil paint vehicle made from wool grease consists of one part of an unsaponifiable drying oil and two parts of magnesium soap. It is described as a tough product, dissolves in paint thinners to fluid solutions in the cold, and is readily pigmented. A large plant is now in regular operation to meet the steady demand for this product.

Neutralized wool grease—in which the free fatty acids originally causing acidity are neutralized by magnesium to form magnesium soaps—finds a wide range of applications in four grades: The hard quality serves as a lanolin substitute, for solution in solvent and application as protective paint; the medium quality is a grease with tenacious greasy properties, made by chilling-drum plant and superseding petroleum jelly as a rust preventative for cast iron and steel parts; the soft quality is described as oily, untexturated medium grade, and rather crystalline in character due to precipitation of magnesium soaps out of solution. Melted to a smooth liquid at above 80 deg. C., it is ideal for the dipping of cast iron articles and corrugated steel sheets; for the manufacture of dubbin a special type of neutralized wool grease is used to which one-quarter (by weight) of paraffin wax has been added; it is practically neutral, most water-repellant and penetrating, and of a very satisfactory texture.

Byproducts from coke-ovens and tar distilleries which did not command a ready market have found special interest for substitution purposes. Products in the soft pitch range are now used on a large scale as saturants for roofing felts, waterproof membranes, paints, etc. The firms which had special experience in this trade have pooled their knowledge. Considerable quantities of creosote oil always have been used in the hydrogenation plant, and a mixture of three parts of petroleum diesel oil and one part of washed light creosote is now used as a motor fuel for busses. Operations with it are satisfactory. The fuel gives increased mileage per gallon, and if freshly prepared tar oil with low content of tar acid is used, very little sludge is formed. Another new motor fuel, still in the experimental stage, for motor busses is crude naphtha, supplemented by gasoline or gas for starting. Tar is used with good results in road work where imported bitumen used to be employed. In some parts of the country formerly neglected byproducts are now so much in demand that committees of producers and distillers direct the output into the most desirable channels.

Fortunately tar distillers can draw upon sufficient raw material. The output of crude tar has increased substantially in recent years. While between 1934 and 1937, 400-500 coke-ovens were built annually by British construction firms, though not entirely for the home market, the number of orders received in 1939–1941 was 179, 74 and 111 only. This decline has its cause in the fact that the British coking industry entered the war in a relatively healthy state with sufficient capacity. Much of total capacity was not more than six years old and stood up well to the exceptional wartime needs. Nevertheless it is expected that rather more than the average amount of construction work—estimated at 250-300 ovens a year—will be required for some years after the war, to say nothing of orders resulting from changed practices.

The need to rely on indigenous raw materials and to do without some of the substances available before the war has given a stimulus to research in the English pottery trade. Experiments have been made with a mineral phosphate body instead of bone, a de-airing method designed to increase the life of plaster molds, a vitrous body for sanitary ware, permeability of glazes, low-temperature colors and on other subjects. The substitution of alumina for flint in china bedding has been successful. As the pottery industry—"telescoped" to a fraction of its peacetime extent—cannot supply enough domestic china and earthenware, the supply will be helped out by over 10,000,000 plastic cups, mugs and breakers for which the Controller has agreed to provide the raw material before the end of August.

The production of ground basic slag has been substantially increased since the war began, and now a grinding plant is being installed to treat the whole output of suitable slag. The collection of bones has made great progress since cooperative methods have been put into effect in consultation with the Ministry of Food and helps to provide phosphatic fertilizers. The large prewar imports of rock phosphates cannot of course be replaced by such means alone; investigations were therefore undertaken whether certain low-grade phosphate deposits in the British Isles could be worked. Potassic flue dust is another new fertilizer material introduced. Nearly 10,000 long tons of the material have by now been distributed in two grades containing 12-16 and 8-9 percent of K_2O.

Camouflage paints for concrete runways and factory roofs are required in large quantities, and the British Standards Institution has issued specifications for suitable materials. No objection is raised to the existence of a slight degree of acidity or alkalinity because Portland cement and magnesium oxychloride are alkaline substances and slight departure from neutrality will have no harmful effects. Similarly quite a large proportion of relatively coarse particles is tolerable in pigments for concrete. More stringent are the rules laid down with regard to lead and zinc compounds (which should be made the object of a test when present in quantities of more than 0.1 percent). Seven types of natural and artificial pigments are sufficient to produce most colors required except blue: chromium oxide, manufactured hydroxides of chromium, red oxide of iron, carbonaceous black pigments, black oxide of iron, yellow oxide and hydroxide of iron (including natural ochres), and brown oxide of iron (including sienna and umber). For some of these, two strengths of pigment are specified to permit use of natural matters of low pigmenting power for pale colors. In general, however, it is admitted than the strongest colors will be the most economical.

Since urea-formaldehyde resins were first used to improve the fastness to light and washing of textile dyes, much

progress has been made in Lancashire in the use of other synthetic resins for similar purposes. Dimethylol urea, formed by condensing one molecule of urea with two molecules of formaldehyde and heated under slightly acid conditions, yields a solution which has been found very useful for this purpose. Resins obtained by heating melamine with formaldehyde have also shown considerable fastness to washing, and if these or similar synthetic products are used as binders for dyes in place of albumen or other substances, the result can be very satisfactory. The improved dye fastness resulting from the use of synthetic resins is partly due to the fact that they enable some dyestuffs to penetrate the fiber more thoroughly and on the other hand reduce swelling of cellulose materials in water, so that the dyestuffs cannot be washed out so easily, but more knowledge of the causes of the improved fastness of resin-treated textiles is required. At present progress is still largely by trial and error.

In Eire wartime difficulties in the import trade have been a great help to firms desiring to establish local chemical industries. Not all of these may be able to survive after the war, but what has been done is certainly worthy of special notice. A small calcium carbide plant has been set up in County Limerick. A factory making starch, glucose and flour from potatoes will be reopened in Athlone after having been closed for twelve years. Special plant for the utilization of waste carbon dioxide from the fermenting vats has been erected by Industrial Gases (Irish Free State) Ltd. at Guiness' Brewery, Dublin. Iron pyrites are now being mined in Wicklow by the Mineral Exploration and Development Co. for the production of sulphuric acid. Phosphates are mined in County Clare in sufficient quantity to supply Eire with one-quarter of her normal consumption of superphosphates. Formalin is being produced by catalytic oxidation of methyl alcohol at the Riverstown (Louth) distillery of Irish Industrial Alcohol Co. Three factories are now producing industrial alcohol from potatoes. The production of acetic acid, acetone and methyl alcohol from wood has begun at a factory in County Kildare.

AMERICAN CAN DEVELOPS NEW FIBER CONTAINER

The American Can Co. has developed a method for making cans with fiber bodies on the same machines which are used in turning out metal containers. Under this method, paper will be run through the various tin can lines. The fiber, cut to sheets of tin plate size, lithographed on presses formerly used for lithographing design on tin plate, will then be sheared and formed into bodies. The ends will be seamed on to the container with the regular seaming machine now in use. The method will be made available to the entire can industry during the duration.

Today's Battle Against Rising Costs and Wartime Scarcities Opens Up New Horizons For Tomorrow's Production... with A T & M

A T & M . . . centrifugal headquarters in the battle for increased production . . . has solved many tough problems for its customers through engineered centrifugal forces. Specially designed, adapted or standard A T & M centrifugals have lowered costs, cut process time, saved floor space . . . and in some cases improved both product and process for wider markets, increased sales.

BETTER THAN A FILTER FOR PROFITABLE RECOVERY OF A SCARCE CHEMICAL

Filtering precious soluble salts from insoluble matter was slow, costly, and barely profitable for a certain important manufacturer. The substance had never before been centrifuged. Working in the laboratory, A T & M engineers devised a machine which averaged 95% recovery, and cut process time in half. No slow piling up of material on filter medium. No double filtrations for super-fine substances. No loss of material being filtered.

LOWERED PROCESS COST 90% BY COMBINING IMPREGNATING AND DEHYDRATING OPERATIONS

A tremendous medium-priced market awaited the manufacturer who could successfully lower production costs of processing and introducing a certain malaceous derivative into his product. A special centrifugal, designed and integrated for a complete production line by A T & M engineers . . . cut costs 90% in time of process, supervision, and cost of power and floor space. Positioning of parts to be impregnated were conveniently arranged inside basket, uniform impregnation assured; at the same time, drying was speeded without expensive, space-consuming drying equipment.

FASTER, MORE THOROUGH THAN TANKS IN CLARIFYING A STUBBORN SLUDGE

An expensive sedimentation process seemed inevitable in clarifying a sticky sludge that had resisted all previous attempts to centrifuge. Studying the problem, A T & M engineers designed a free-wheeling device connected with a gear reduction motor to provide a fixed unloading speed . . . and a specially designed opening in the centrifugal basket for the sludge. Advantages included immediate precipitation, finer degree of clarity, dryer cake . . . and both time and floor space saved for other uses.

TODAY'S PLAN MAY BE TOMORROW'S PROFIT

Along with certain well-defined war orders, A T & M engineers are available for consultation as national needs permit. Many firms, in improving their process, have built added safeguards for the future through centrifugal planning with A T & M. Address 1415 Hyde Park Avenue, Boston, Mass., or 30A Church Street, N. Y.

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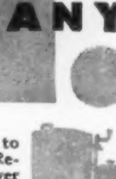
Link Suspended A T & M Smooth operation with "out of balance" loads. An A T & M-designed link guarantees absolute minimum of foundation vibration. Fume-tight covers; spray pipes; specials.

Suspended A T & M For heavy chemical service. Self-discharging baskets, Twin-Speed Regenerative Drive for entire batteries, positive control — and all other accessories when specified. Laboratory units.

Base Bearing A T & M Motors built to A T & M's own specifications. Removable baskets, if desired. Cover cannot open while centrifugal is in use. Easily accessible brakes. Outer casing of solid iron or steel.



READERS' VIEWS AND COMMENTS

TIPS FROM ONE WHO KNOWS

An engineer well known to the editors of *Chem. & Met.* who has had a lot of experience in presenting his company's problems to various governmental agencies in Washington, is well qualified to offer advice to others who have not yet traveled this road. In a private communication, he writes:

"There is no use trying to stem the tide and to do things differently from the way Washington requests. If we do exactly as we are told, we shall have the least trouble. This suggestion is made in all seriousness for it can be established that by far the greater part of all the troubles that applicants have with priorities are their own fault, at least in the sense that the applicant has not seriously studied his proposals from the viewpoint of the man or men who must act upon them. With that in mind, I am glad to pass along the following advice to *Chem. & Met.* readers:

"The next time you get an application ready to send to Washington, don't send it. Keep it for a few days. Study it over critically. First look for the facts in your presentation that justify action. Find out whether there are enough to justify your approving the application if you had the responsibility for controlling the materials so that the war might be best served. If you find that the facts are inadequate go back into your data and see whether there are not some more that properly belong in the record. Frequently you will find that you have overlooked your strongest arguments.

"If you are not satisfied that you have a case do not send in your application.

"If you are satisfied that the facts as presented justify approving the proposal, still don't send it in. Read it over again. Just imagine yourself sitting in hot Washington in one of those temporary buildings with your desk piled high with papers that have to be handled; with the poor type of help that is all too evident; with the telephone bothering you continually; with endless staff meetings to attend; with visitors to satisfy; and with the prospect of working again tonight even though you have worked every night in the week so far.

"Just imagine yourself working under these circumstances and feel just as patriotic as you like about giving service to an outfit that is trying to get on with some war work. Then decide whether you have so presented your case that it would be easy for you, as a stranger to your case, to understand what you are trying to say and to prove. Will you say to yourself that there is a fellow who really knows what he wants and why, and that he has done a fine job of telling about it? Would you pass it on with your blessing? Or would you say to yourself 'Maybe he has something there but I am too tired or too busy to find out what it is' and then put it aside to try again tomorrow?

"Many of the analysts in W.P.B. do just that. Some classify their work in three piles. One is for the cases that are well presented and easy to understand and have enough merit to pass without too many readings and questions. The next pile is for the cases that may be well presented but concerning which there are questions to be answered. The third pile is for those that are hard to understand. Naturally, they are worked on least. As new applications come in they have to be moved on and Pile No. 3 has to wait.

"As you read your application before you send it in, decide into which pile you would put it. If it does not merit a place in Pile No. 1, do it over until it does. You will save your time and that of the many analysts who have to worry about it.

"If every applicant would take this time and trouble to analyze and properly present his case there would be less ground for complaint about the service in Washington.

"Even after you are satisfied that the facts justify approval and that you have presented your case in a thoroughly understandable form, still don't send it in. Read it again and determine whether you actually have to have all of the critical material that you are asking for. After all, no one should know better than you what you need and why you need it. It is part of the duty of those who are building plants to know what is scarce, how scarce it is, and the relation between that scarcity and the need for the material to accomplish the result. Apply to each such item the same critical analysis that you applied to the project as a whole to determine whether it is worthy of approval. If you are convinced that a given item is needed and that there is no suitable substitute, considering the war conditions, you must know why you think so. Then see to it that you set down your reasons in the applications. Someone has to reason this out. If you leave it to W.P.B. your views are not likely to be weighed. If you tell W.P.B. your reasons then you have a fair chance of getting a proper hearing. If you don't take this trouble, don't complain about W.P.B.'s actions."

FOR MATHEMATICAL PURISTS

To the Editor of Chem. & Met.:

Sir:—No doubt several Chem. & Met. readers have already commented on the article on tank calibration which appears on page 95 of the April issue. In view of the tolerances of tank manufacture, the tables are more accurate than would normally be required. However, Mr. Deane used a step-integration for the standard dished head since "it was not found possible to obtain a function for the volume of the head

at a given depth." The same method was used for conical heads, presumably for the same reason.

In the interest of mathematical analysis, rather than because of the dubious practical value of the equations, the writer would like to point out that the integration for the volume of spherical heads and of conical heads can be performed and the following equations obtained.

For horizontal cylindrical tanks with spherical heads: Let r=radius of head, R=radius of tank, $s=r/R$, V=volume of single head at depth h, $t=h/R$. Then:

$$V = R^3\left[\frac{2\,s^3}{3}\tan^{-1}\left(\frac{s}{1-t}\sqrt{\frac{2t-t^2}{s^2-1}}\right)\right.$$
$$-(1-t)\left(s^2-\frac{(1-t)^2}{3}\right)\tan^{-1}\sqrt{\frac{2t-t^2}{s^2-1}}$$
$$+\frac{2\,(1-t)}{3}\sqrt{(s^2-1)\,(2t-t^2)}$$
$$\left.-\frac{1+2s^2}{3}\sqrt{s^2-1}\,\sin^{-1}\sqrt{2t-t^2}\right]$$

It will be noted that this formula applies for any value of r/R greater than 1. For the standard dished head with $r=2R$, the above expression simplifies as follows:

$$V\Big]_{r=2R} = R^3\left[\frac{16}{3}\tan^{-1}\left(\frac{2\sqrt{3}}{3}\,\frac{\sqrt{2t-t^2}}{(1-t)}\right)\right.$$
$$-(1-t)\left(4-\frac{(1-t)^2}{3}\right)\tan^{-1}\left(\frac{\sqrt{3}}{3}\sqrt{2t-t^2}\right)$$
$$+\frac{2\sqrt{3}}{3}\sqrt{2t-t^2}\,(1-t)$$
$$\left.-3\sqrt{3}\,\sin^{-1}\sqrt{2t-t^2}\right]$$

For horizontal cylindrical tanks with conical heads: Let R=radius of tank, d=altitude of cone from base to apex, V=volume of a single head at depth h, $t=h/R$. Then, for any value of t between 0 and 1:

$$V = d\,R^2\left[\frac{\pi}{6}-\tfrac{2}{3}\,(1-t)\sqrt{2t-t^2}\right.$$
$$-\tfrac{1}{3}\sin^{-1}(1-t)$$
$$\left.+\tfrac{1}{3}\,(1-t)^3\log\left(\frac{1+\sqrt{2t-t^2}}{1-t}\right)\right]$$

In the above expressions all angles should be expressed in radians and logarithms to the base e.

J. W. LANGHAAR

CORRECTION

The editors regret the omission of credit lines in connection with the article "Avoiding Formation of Hydrocarbon Hydrates" by Ira C. Bechtold, the Fluor Corporation, Los Angeles, published on pages 136-137 of our May 1942 issue. The article which appeared in this magazine was an interpretation of the complete paper presented by Mr. Bechtold at the March 1942 monthly meeting of the California Natural Gasoline Association, Los Angeles.

BCP JACKET WATER COOLER
Constructed of Anaconda seamless copper tubes, copper-nickel alloy tubes and stationary tube sheets with baffle and support plates of brass. Fabricator was Ross Heater & Mfg. Co., Inc.

EVERDUR BUBBLE-CAP FRACTIONATING COLUMN
38 feet high and 5 feet in diameter, this column is completely fabricated of rustproof, corrosion-resistant Everdur. Construction includes 116 three-inch cast Everdur bubble-caps. Designers and fabricators were the Vulcan Copper & Supply Co.

ANACONDA from mine to consumer

Anaconda Copper & Copper Alloys

PERSONALITIES

R. L. Sibley

Crosby Field

✦ R. L. Sibley, director of research of the Rubber Service Department of the Organic Chemicals Division of Monsanto Chemical Co., has been appointed general manager of manufacturing in charge of all production and research activities at Nitro, W. Va. Dr. Sibley in turn announced the appointment of Dr. David J. Beaven as research director of the Rubber Service Department, and Harry A. Merkle, production superintendent of the Nitro plant, as plant manager succeeding Herman K. Eckert, who had been named plant manager of Monsanto's synthetic rubber chemicals plant in the South. Mr. Sibley was born May 24, 1888, in Spencer, Mass. and studied at Clark College and Clark University, obtaining degrees in physics and chemistry. He continued his education in chemistry at Princeton University, then for two years engaged in the study of law at New York University.

✦ Melvin DeGroote received a professional degree in chemistry and chemical engineering at graduation exercises of Ohio State University. He is chief chemist of the Tret-O-Lite Co. of St. Louis, which he joined about 1925. Mr. DeGroote is the holder of approximately 275 patents on oil-de-emulsification and similar subjects and is one of the outstanding authorities in this field.

✦ Thomas J. Knapp, former traffic manager and assistant sales manager of Freeport Sulphur Co., has been elected assistant vice president by the board of directors. Mr. Knapp was also made assistant vice president of the Freeport subsidiaries, Cuban-American Manganese Corporation and Nicaro Nickel Co.

✦ Gregory J. Comstock, professor of powder metallurgy at Stevens Institute of Technology, Hoboken, N. J., has been appointed technical consultant of the U. S. Board of Economic Warfare in the Industrial Engineering Division.

✦ Crosby Field has been called into active service as colonel, Ordnance Department and is serving as assistant director of safety, explosives safety branch, Office of Chief of the Ordnance. This War Department branch is charged with heavy responsibilities in connection with the safety and security of plants manufacturing for the Ordnance Department in which an explosive hazard is involved.

✦ L. C. Turnock, Jr., is now a lieutenant in the Chemical Warfare Service. He is located in Rochester, N. Y., where he is looking after various interests of the Procurement Division of that branch of the service.

✦ Raymond Mattson of Vancouver, Wash., has been awarded the $1,000 industrial fellowship in colloidal chemistry, sponsored by The Arco Co., Cleveland, Ohio. Mr. Mattson is a teaching fellow in the graduate school of Western Reserve University, where he received his master's degree in 1941. He is now engaged in work for his doctorate at that university.

✦ J. C. Carlin, formerly of the Gaither Chemical Co. of Nashville, Tenn., is now on the War Production Board. He is in the Division of Industry Operations, Chemicals Branch, Solvents Unit.

✦ Andrey A. Potter, dean of engineering of Purdue University, Lafayette, Ind., has been appointed executive director of the National Patent Planning Commission, it was announced recently by Dr. Charles F. Kettering, chairman of the organization. During the first World War, Dr. Potter served as an associate member of the United States Naval Consulting Board, having previously been director of industrial preparedness of the State of Kansas in 1917-18. Since 1940 he has been chairman of the National Advisory Committee on War Training and Engineering, Science and Management, and expert consultant of the U. S. Office of Education.

✦ Julius A. Berninghaus, general manager of sales of the Organic Chemicals Division of Monsanto Chemical Co., has been promoted to general manager of the division. He succeeds John W. Livingston, who resigned to become consulting engineer to the Rubber Reserve Co., the federal agency dealing with the provision of facilities for synthetic rubber production. Mr. Berninghaus was born in St. Louis in 1878. He was educated in the Polytechnic Institute and in night law school. He joined Monsanto in 1926 as a departmental sales manager, becoming general manager of sales in 1929. In 1939 when the company was set up along divisional lines, he became ranking sales executive of the Organic Chemicals Division and senior sales executive of the company.

✦ J. Edward Todd has been appointed assistant to Dean Harry F. Lewis of the Institute of Paper Chemistry. Dr. Todd comes to the Institute with practical experience in education and college administration. He received his A.B. degree at the University of Kansas in 1918, his M.A. degree in 1934 and his Ph.D. degree in 1940, both from Teachers College of Columbia University. After spending some time abroad, Dr. Todd became business officer of Cornell College, Mt. Vernon, Ia., in 1923. In this capacity, he was responsible for the management of investments under the direction of the Loan Committee of the Board, for the management of the physical plant and the operation of the residence and dining halls. From 1928 to 1937 he was at Carleton College where he was director of admissions and secretary of personnel service, and assistant professor of psychology and education. From 1937 to 1941 he occupied similar positions at Springfield College, the change being made that he might be nearer his graduate studies.

✦ Renton K. Brodie has been elected vice president of Procter & Gamble to fill the vacancy caused by the death of Herbert G. French. Harvey C. Knowles was elected director and vice president in charge of manufacturing to succeed Mr. Brodie.

✦ A. Garrell Deem, assistant professor of chemical engineering, University of Illinois, recently received orders to report for active duty with the Chief of the Chemical Warefare Service, Washington, D. C.

✦ V. E. Wellman has been appointed manager of the recently created chemical and pigments department of the purchasing division of the B. F. Goodrich Co. The new department will be responsible for the development of new

sources of these materials, and the procurement of them for both the chemical products and rubber manufacturing divisions of the company. Dr. Wellman, born in Denver, Colo., received his bachelor of arts degree from Phillips University and his master of science and doctor's degree in chemistry from the University of Washington. Joining the B. F. Goodrich Co. in 1929, he worked on many projects in the chemical research department, and was made manager of the chemical laboratories in 1939. Two years later he became special technical assistant to T. G. Graham, vice president in charge of manufacturing operations.

✦ Robert P. Moffett and Frederick W. Orttung, Jr., have joined the research and development laboratories of the Bakelite Corp., Bloomfield, N. J. Mr. Moffett is a graduate of Duke University with a B.S. and M.A. degree, and Mr. Orttung is a graduate of the University of Pennsylvania with a B.S. degree in chemistry.

✦ E. H. Bucy of Noroton, Conn., has been appointed to head the Protective Coatings Section of the Chemicals Branch, W.P.B. Dr. Bucy joined W.P.B. in January, 1942, and has been head of the Paint, Varnish, Lacquer and Printing Inks Unit of the section. He has severed his connection with the Zapon Division of Atlas Powder Co., of which he was technical director.

Charles D. Goodale

✦ Charles D. Goodale has been appointed manager of the Technical Service Division of Commercial Solvents Corp. with offices at Terre Haute, Ind. This division is a combination of the sales promotion division and the trade relations division. This new division will handle all promotional activities of Commercial Solvents including advertising, market development and sales promotion.

✦ Robert D. Macdonald has been named research engineer of the technical staff of Battelle Memorial Institute, Columbus, Ohio, where he has been assigned to the materials beneficiation division. Mr. Macdonald is a graduate of Montana School of Mines

and Massachusetts Institute of Technology. Prior to joining the Battelle staff he was associated with the General Engineering Co., Salt Lake City, Utah.

✦ Charles P. Kirchen, formerly of Hollingsworth & Vose Co., Boston, is now in the research laboratory of the International Business Machines Co., Endicott, N. Y., where he is working on problems connected with the paper industry.

E. C. Williams

✦ E. C. Williams has been appointed chemical director and vice president and has been elected to the board of directors of General Aniline & Film Corp. With Dr. W. F. Zimmerli, vice president in charge of patents and research, and other outstanding technical men recently added to the staff of General Aniline, it is felt that the laboratory will soon occupy a high place among the research organizations of the American chemical industry. Dr. Williams comes to his new position from the General Mills, Inc., Minneapolis, where he has been vice president and director of research for the past year.

✦ Norman Clark, formerly of Ault & Wiborg Co., Cincinnati, is now in the chemical research department of the Springfield Coated Paper Co., Camden, N. J.

✦ John C. Madigan, who graduated from the chemical engineering department of Columbia University in 1942, is with the United States Rubber Co. at its plant at Naugatuck, Conn. Eventually he will be assigned to the company's new plant at Charleston, W. Va.

✦ Richard W. Raymond of the Missisquoi Corp., has been commissioned an ensign in the U. S. Naval Reserves. Ensign Raymond is a graduate of the University of Maine where he specialized in paper chemistry.

✦ Ralph R. Wenner, author of "Thermodynamic Calculations" and formerly with Solvay Process Co. at Syracuse, N. Y., is now in the Research Division

of General Aniline & Film Corp. at Grasselli, N. J.

✦ F. L. Mark will head the technical and research staff of the Dicalite Co.'s recently established asphalt section in the laboratory at their California plant. Mr. Mark is a graduate in chemistry from De Pauw University. His experience covers 20 years of research, production, engineering and sales work in the asphalt industry.

✦ R. F. Merrill has been loaned by the Andrew Jergen Co. Ltd., Perth, Ont., to the Polymer Corp., which is concerned with the production of synthetic rubber in Canada.

✦ Johnstone S. Mackay has accepted a position with the American Cyanamid & Chemical Corp. at its laboratories located in Stamford, Conn.

✦ A. Brothman and A. P. Weber, both formerly of the engineering department of Hendrick Manufacturing Co., have affiliated themselves with Chemurgy Design Corp., a division of Golwynne Chemicals Corp., New York. They will supervise the engineering-contracting division as well as the process equipment consulting design activities.

✦ H. K. Clark, vice president and general manager of the Norton Co., who recently returned to Worcester after nine months service as a dollar a year man in the OPM, and WPB, lastly as assistant deputy director of the Division of Industrial Operations, is back in the Capitol. This time he has been drafted by the Navy and with the rank of lieutenant commander is a member of the Army and Navy Munitions Board.

✦ Frank V. L. Patten of Austin, Tex., has been appointed as assistant director of the Division of Reserves by the Office of Petroleum Coordinator. Dr. Patten will have headquarters in Washington, D. C. He leaves his post as chief supervisor of the Oil and Gas Division of the Texas Railroad Commission to assume his new duties in the OPC division headed by William B. Heroy. Born in Oklahoma, Dr. Patten has been a resident of Texas since 1926. He earned his bachelor's degree in chemical engineering, his master's degree in science and his doctorate in philosophy at the University of Texas. Upon graduation Dr. Patten was engaged by the Texas Railroad Commission as a chemical engineer.

✦ C. L. Gabriel, after being connected with the Commercial Solvents Corp. for 22 years, has resigned and joined the executive staff of the Publicker Commercial Alcohol Co. He will devote his energies to the development of new products. Mr. Gabriel is a chemical engineer with B.S. and M.S. degrees from Massachusetts Institute of Technology.

✦ Gilbert Ford Kinney has been called to active service as a lieutenant in the Navy. Dr. Kinney was instructor in chemical engineering at Pratt Institute.

✦ J. C. Brier is on leave of absence from the department of chemical engineering at the University of Michigan. Lt. Col. Brier is an Ordnance Department training officer with the Shell and Bomb Loading School in Ohio.

✦ C. G. Atwater of the Barrett Division of Allied Chemical & Dye Corp. retired July 1. Mr. Atwater had been with the Barrett Division and predecessor companies for nearly half a century. As a young man he was engineer in charge of design and construction of some of the first byproduct coke ovens to be installed in the United States, and later spent many years in developing the agricultural use of sulphate of ammonia. Beginning about 1929 he took a leading part in the introduction of synthetic nitrate of soda to farm consumers.

✦ Ward M. Hanson who graduated in chemical engineering from the University of Minnesota in June, has joined the Westvaco Chlorine Products Corp. Several other additions have been made to the staff. Frank P. Byrne received his masters degree in the chemical department of Creighton University in 1938. Prior to coming to Westvaco, he held a position on the teaching staff of St. Joseph College, Hartford, Conn. Richard W. Cummins is a recent graduate of the chemical department of the University of Michigan. Bradford C. Hafford recently received a Ph.D. in chemistry from the University of Wisconsin. John M. Lenoir is a graduate of the chemical engineering department of the University of Illinois. Edwin P. Plueddemann is a recent Ph.D. graduate in organic chemistry of Ohio State University. William G. Strunk graduated in June from the chemistry department of the University of South Dakota. Dr. Robert M. Thomas graduated from Purdue University in June. Dean D. Watt is from the University of Idaho.

✦ P. W. Blaylock has resigned his position with Shawinigan Chemicals, Ltd., in Shawinigan Falls, P. Q., in order to take charge of a newly formed engineering development department in the Reichhold Chemicals, Inc., Detroit. During the eight years which he spent with the Shawinigan Chemicals he was for some time in charge of the acetic anhydride plant and has recently been working on engineering design and development connected with an expansion program.

OBITUARIES

✦ Carl F. Dahlberg died July 26 in Atlanta, while on his way to New York on business. He was 63 years old. Mr. Dahlberg was born in Sweden and came to this country when young. He spent much of his time in Omaha and Minneapolis. In 1921 he joined his brother,

Bror, in founding the Celetex Corp. and served as its first vice president.

✦ FRANK S. DUNHAM, Permutit Co. sales engineer since 1915, died in Chicago on July 23. Mr. Dunham had been associated with the Permutit Co. in the sales of water conditioning equipment for approximately 25 years.

Henry G. Knight

✦ HENRY G. KNIGHT, chief of the Bureau of Agricultural Chemistry and Engineering in the Department of Agriculture, died July 13, after a brief illness. He was 63 years old. Dr. Knight was born in Bennington, Kans., and was graduated from the University of Washington, receiving his master's degree in 1904. He had been an instructor at the University of Washington, University of Chicago, University of Wyoming, state chemist of Wyoming and later director of the Agricultural Experiment Station there. He also had been dean of the Oklahoma Agricultural & Mechanical College and the College of Agriculture in West Virginia. He became chief of the Agriculture Department's, Bureau of Chemistry and Soils, now the Bureau of Agricultural Chemistry and Engineering, in 1927.

Dr. Knight received the medal of the American Institute of Chemists presented annually for noteworthy and outstanding service to the science of chemistry or the profession of the chemists of America. He was a past-president of the American Institute of Chemists.

✦ CLARENCE A. HALL, chairman of the board of the Bartol Research Foundation, assistant treasurer of the Franklin Institute, and a chemical engineer associated with the Electric Storage Battery Co., died July 20, at his home in Chestnut Hill, Philadelphia, after a heart attack. He was 58 years old. Mr. Hall was a graduate of the University of Pennsylvania, where he received his degree in chemistry. He had been associated with the Electric Storage Battery Co. for 22 years. Previously he had been connected with the Pennsylvania Salt Mfg. Co., the Lake Superior Carbide Co., the Union Carbide Co. and the Lake Superior Corporation.

NEWS OF PRODUCTS AND MATERIALS

CELLULATED GLASS

We have had a new development in the glass industry called to our attention recently. The product is called Foamglas which is quite descriptive because a block of it looks very much like a rubber sponge. Instead of being heavy and transparent like regular glass, it is light, opaque and densely black. It is a true glass which has been cellulated by the evolution of gas at high temperature within the molten mass. It might be compared to pumice in which the pores are of very uniform size. A block of Foamglas is a mass of tiny sealed-air chambers—so many that a cubic foot contains over 5,000,000 of them. The natural inorganic characteristics of glass, plus the unique cellular structure of Foamglas make it ideal for many uses and a valuable substitution for many materials, such as cork, magnesia, and balsa wood, made scarce by war-time conditions. Its principal use probably will be as a heat insulator.

The low heat conductivity readily suggests its application as insulation for cold storage rooms and all types of furnaces and ovens where the maximum temperature does not exceed 1,000 deg. F. It is more rigid and stronger than most materials used regularly for insulation and buoyancy. It will support its own weight in any type of wall construction without danger of crushing or packing. Foamglas is a development of the Pittsburgh-Corning Corp., Pittsburgh, Pa. Properties: Conductivity at 70 deg. F., 45 Btu. per hr. per sq.ft. per deg. F. per in.; coef. of expansion, .0000046; specific heat, .16 to .19 Btu. per lb. per deg. F.; crushing strength, 150 lb. per sq.in.; modules of rupture, 90 lb. per sq.; impact strength, 66 ft./lb. It is available in sections 12 in. x 18 in. in the following thicknesses 2, 3, 4½ and 6 in.

GLASS MAKER'S CHROME

The Office of Price Administration announces a maximum price for an entirely new product found to be useful in the glass industry. The Martin Dennis Co., Newark, N. J., has developed the product, which is manufactured from the chromium-containing residues from the roasting of chrome ore in the production of sodium chromate after the chromate has been extracted. When properly dried, pulverized and air floated, this residue has been found useful in the glass industry. It can replace a chrome ore in imparting color to glass.

LOW-VISIBILITY PAINT

A new type of low-visibility paint possessing exceptional heat deflecting qualities has been developed by the Arco Co., Cleveland, for use in the protective concealment of vital defense structures and equipment. Already in use on certain government properties, the new paint meets tentative Navy specifications for infra-red reflecting paints for use on fuel storage tanks, buildings, and certain types of equipment where dark colors as well as heat reflecting qualities are required. It has been offered commercially under the trade name of Infray and is being manufactured in green, tan, black and four intermediate shades which, when properly selected, will meet the requirements of good camouflage in any sort of terrain. The unusual degree of heat deflection which can be obtained with the darker colors in these paints, promises to be of particular value to public utilities, oil producers and refineries, and to anyone who has to store large quantities of volatile materials in tankage above ground, according to a vice president of the company.

COMPLETE SOAP

Modern washing technique has resulted in the development of a "complete" soap whose introduction is rapidly supplanting the rule of thumb method of mixing soap and alkali. The research organization of the National Oil Products Co., Harrison, N. J., has evolved a compounded mixture of anhydrous soap and a series of especially selected alkalis to which have been added solvents and penetrants. Nopco Complete Soap was prepared for use by launderers of commercial and institutional work where maximum cleanliness, whiteness and clean odor are essential. It advantages are said to include greater detergency because of superior soil-removing power; sufficient suspending ability to insure the retention of foreign matter so that it is easily carried away in the rinse; quick rinsing to save time and assure clean, odorless, whites and fresh, bright colors, and specially selected penetrants insure the utmost stain removal with a minimum of bleach.

BLACKOUT BULB

The war is responsible for the development of a blackout bulb which can be kept burning for emergency lighting without the need for window shades or blinds. It has been approved by the War Department and is now ready for use in war plants and government buildings throughout the nation, according to the announcement of the Lamp Division of the Westinghouse Electric & Mfg. Co., Bloomfield, N. J. The new lamp bulb gives a faint glow of orange light sufficient to clearly distinguish objects in a room, but not enough to be visible from the air, even though faced directly in line with an open window. In war factories, the bulb will be installed along manufacturing aisles or stairways and in halls. During a blackout this light would

enable workers to move about safely, switch off machinery or perform other simple emergency operations. Although these bulbs are now available only on high-priority rating, the W.P.B. may permit civilian use of the bulb in sections of the country defined as blackout areas. Resembling in appearance the familiar household light bulb, the blackout lamp is coated with an outer covering of black except for an orange-red opening through which a narrow beam of light passes. The downward direction of this beam prevents any direct rays of light from being seen by planes. Operated at 15 watts, each bulb will provide emergency lighting for an area of approximately 200 sq.ft.

TREATING LUMBER

Urea, which was not even manufactured in this country until very recent years, is being widely used to inhibit splitting and checking of lumber during the necessary seasoning or drying process, and also to treat wood so that it may be bent and shaped for certain uses. Some mills that tried to dry lumber without urea experienced seasoning degrades of 40 to 60 percent of the stock dried and in addition tied up their dry kilns for an unreasonably long time. These seasoning difficulties were largely solved by the use of urea and kiln degrade of this important farm-grown crop of lumber was reduced to around 3 percent. Consideration is being given by large contractors to possible use of urea-treated lumber in the construction of plants. Only recently word was received that to obtain specific information aimed to shorten the time required to season hardwood lumber, the Forest Products Research Laboratories of the Texas Forest Service in cooperation with the East Texas lumber industries is treating green white oak, red oak and sap gum lumber with urea. The wood will be subjected to controlled drying conditions in modern dry kilns. East Texas lumbermen expect the experiment will produce valuable information for local application within a few months. The U. S. Forest Products Laboratory and the West Coast Lumbermen's Association are among the pioneers in the development of chemical seasoning.

RUBBER HEEL UTILIZES WOOD CORE

The construction of a new type rubber heel utilizing a wood core conserves approximately $1\frac{1}{2}$ oz. of compounded rubber and 1/5 oz. of steel on each pair of half heels of the standard one-half inch size, according to the announcement of the B. F. Goodrich Co. of Akron, Ohio. The standard rubber $\frac{1}{2}$ in. pair of heels weighs approximately $5\frac{1}{2}$ oz. of which the steel insert washers weigh 1/5 oz. leaving the weight of the rubber compound approximately 5.3 oz. The new type wood core insert heel of the same size weighs approximately 4.8 oz. with the wood core weighing approximately 1 oz. leaving the rubber compound weighing 3.8 oz. It is the belief of Goodrich that this type heel could be used on all the 150,000,000

pairs of men's and boys' shoes produced annually and that based on this volume there would be a saving of 10,000,000 lb. or 5,000 tons of compounded rubber plus a saving of 1,700,000 lb. or 850 tons of steel used in the steel washer insert utilized in previous construction.

CHLORINATED ORGANIC CHEMICALS

From the research laboratories of the Pennsylvania Salt Manufacturing Co. have come three chlorinated organic chemicals with interesting properties and possibilities. They may aid in replacing restricted essential materials or help in developing new products.

*2, 2, 3, Trichlorobutyric Acid**

Physical Properties:

Appearance—white crystalline solid.
Molecular Weight—191.5.
Melting Point—60°C.
Boiling Point—236°C. with only slight decomposition at the boiling point.
Hygroscopic.
A slightly stronger acid than trichloroacetic acid.
Mild odor.
Soluble in water.
Soluble in organic solvents.

*Available as a white crystalline solid, in 60% aqueous solution, or in other strengths.

1, 1, 1, 2, 3, Pentachloropropane

Physical Properties:

White crystalline solid.
Melting not lower than 178°C. for pure grade, 140°C for technical grade.
Sublimes.
Has odor of camphor.
Soluble in organic solvents.
Insoluble in water.

Tetrachlororesorcinol

Physical Properties:

White crystalline solid.
Melting Point—141°C.
Faint pleasantly phenolic odor.
Soluble in organic liquids, hot water or dilute alkali—sparingly soluble in cold water.

Chemically, it is a mild reducing agent, and with chlorine yields hexachlorocyclohexene-1-dione, 3-5, a quinone of interesting possibilities.

ALKYL PHOSPHORIC ACIDS

Five new alkyl phosphoric acids are now available in experimental quantities. The patents indicate their value as catalysts and polymerizing agents in the production of resins, as polymerizing agents in the processing of drying oils, and as water-insoluble, rust- and corrosion-proofing compounds. They are as follows:

Ethyl phosphoric acid

Specific Gravity: 1.33 at 25 deg. C.
Color: pale straw-colored liquid.
Alkyl acid content: approximately 97%

Normal butyl phosphoric acid

Specific gravity: 1.24 at 25 deg. C.
Color: fluorescent reddish amber
Alkyl acid content: approximately 99%

Amyl phosphoric acid

Specific gravity: 1.33 at 25 deg. C.

Color: fluorescent reddish amber
Alkyl acid content: approximately 99%

Methyl phosphoric acid
Specific gravity: 1.439 at 25 deg. C.
Color: pale straw-colored liquid
Alkyl acid content: approximately 97%

Normal propyl phosphoric acid
Specific gravity: 1.30 at 25 deg. C.
Color: reddish amber
Alkyl acid content: approximately 97%

While the raw materials situation makes supplying of commercial quantities uncertain at present, experimental quantities are available from the Monsanto Chemical Co., Merrimac Division, Everett Station, Boston, Mass.

COMPOUND FOR REMOVING RUST

Ordinary methods used for cleaning steel tools are at present not the most effective that can be used, because they do not rustproof the metal after it has been treated. As a matter of fact, while ordinary pickling cleans the metal, it does not prevent rust growth, but instead has a tendency to accelerate corrosion. Corrosol No. 26 made by the International Rustproof Corp., Cleveland, Ohio, is said by the management not to promote the growth of corrosion after treatment, but instead leaves the metal in a clean, passive condition. Furthermore, because it does not act upon the metal itself, it does not dull the cutting edge of tools as ordinary pickling baths do. It not only removes rust, but also eliminates blemishes, burn marks, etc.

GLYCERINE SUBSTITUTE

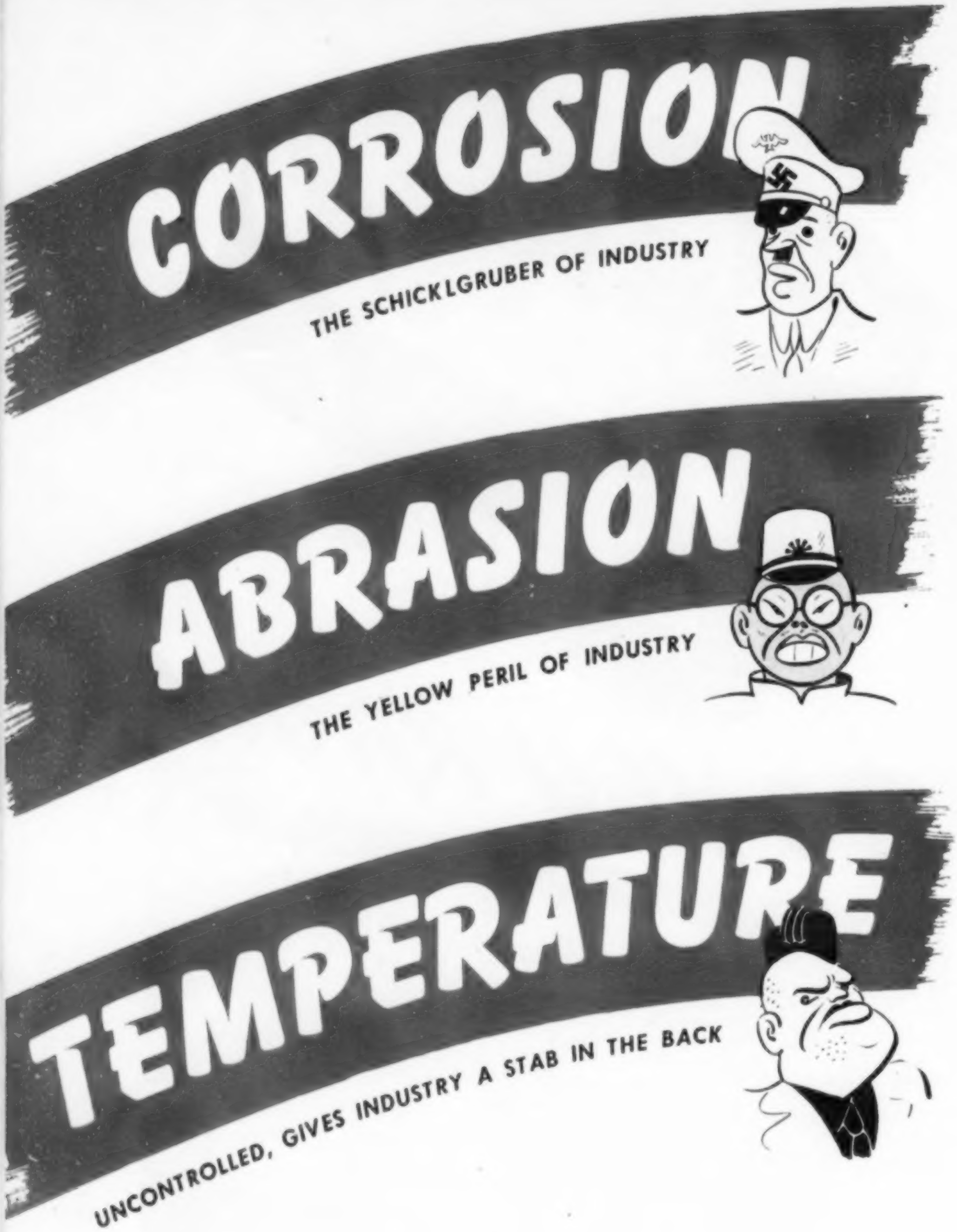
An aqueous, non-toxic liquid made mainly from corn and known as Akerite Glycerine Alternative has been announced by Akerite Chemical Works, Chicago, Ill. It is soluble in alcohol, water and glycerine, but insoluble in petroleum solvents. Like glycerine it attracts water during storage and has a low freezing point.

GENERAL-PURPOSE PLASTIC

Through a minor revision in its formulation, Durez 11540 phenolic molding compound is said by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., to have been made adaptable to many new uses. It has slightly higher impact strength and greater water resistance than former top-grade general-purpose materials. It is said to deliver excellent surface finish.

A SYNTHETIC FLEECE

Made from the waste leftovers of war production, nylon fleece is a natural for many items, notably, men's, women's, and children's coats and bathrobes, and all kinds of blankets. Developed in the laboratories of Cohn-Hall-Marx, nylon fleece already is getting heavy promotion in coats. Government restrictions on the use of wool now imperil the supply of quality merchandise in these lines.



Are these Saboteurs at large in Your Plant ?

Chem & Met's 10th Materials of Construction Issue, coming in September, will give you the basic information on materials and equipment to help you STAMP them OUT.

● Chem & Met's 10th Materials of Construction issue is coming next month. To many of you long-time subscribers, this event needs no further introduction, except to say that, because of the war, there will be emphasis this year on (1) substitutes for scarce materials, (2) how to make your present equipment last longer, and (3) what's going to happen after the war when certain materials of construction are available in superabundance?

To young chemical engineers and other new readers of Chem & Met, the principal feature of these Materials of Construction issues is the complete data which they offer on the chemical, physical and mechanical properties; the available forms; and the manufacturers and trade names of hundreds of types of metallic and non-metallic construction materials.

Chem & Met's editors are surveying the whole

CHEM & MET NEWS OF MEETINGS & CONVENTIONS

A.C.S. and T.A.P.P.I. Plan to Meet in September

AMERICAN CHEMICAL SOCIETY MAKES PLANS FOR NATIONAL MEETING

DR. NELSON ALLEN, supervisor of research in the Cellophane Section of E. I. du Pont de Nemours & Co., Inc., Buffalo, N. Y., has been named general chairman of the 104th national meeting of the American Chemical Society to be held in Buffalo, September 7–11. Seventy-two sessions have been scheduled by 17 of the Society's 18 professional divisions. The Division of Petroleum Chemistry, the only one not meeting, was forced to cancel its sessions because of the pressure of war work.

Dr. R. Norris Shreve, Purdue University, will preside at a symposium on unit processes to be held by the Division of Industrial and Engineering Chemistry. "Administrative Problems of the Research Laboratory" and "Manufacture and Use of Solvents" are among the other special topics of this division, of which Dr. Lawrence W. Bass, assistant director of Mellon Institute, is chairman.

Outstanding agricultural authorities will present a symposium on potash, according to Dr. H. B. Siems of Swift & Co., chairman of the Division of Fertilizer Chemistry. Dr. G. R. Mansfield of the United States Geological Survey will open the symposium with a discussion of American potash deposits and reserves. The war-time contribution of the American potash industry will be described by Dr. John W. Turrentine, president of the American Potash Institute, who has been appointed chairman of this symposium. Twelve other scientific papers to be presented will trace potassium through its chemical and biological functions from the soil solution to the harvested crop.

Chemical aspects of food preservation by canning, dehydration and refrigeration will be the subject of a special symposium to be held by the Division of Agricultural and Food Chemistry. Another symposium will be devoted to a discussion of the processing of food for the military forces and protection of food against war damage. A joint session of the Divisions on Agricultural and Food and Biological Chemistry will center on new developments in vitamins and proteins.

Research in rubber and rubber substitutes will be discussed at four sessions of the Division of Rubber Chemistry, headed by Dr. John N. Street, manager of the Research Division of the Firestone Tire & Rubber Co. Uses of coal by various industries will be discussed by the Division of Gas and Fuel Chemistry, and recent developments in drying oils will be the principal theme of the Division of Paint, Varnish and Plastics Chemistry. Technical education in wartime will feature discussions at a national assembly of chemical educators under auspices of the Division of Chemical Education.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING

THE ADVISORY Committee for the 15th National Exposition of Power and Mechanical Engineering, to be held in New York, November 30 to December 5, has re-elected Irving E. Moultrop as chairman, with John H. Lawrence as vice chairman.

One hundred and twenty-five companies have engaged space for the 1942 exposition. Displays will concentrate on suggesting methods for winning the war by increasing production from existing equipment, by preventing shutdowns and by insuring continuous operation. The Exposition, with permanent headquarters at Grand Central Palace, New York, is under the management of International Exposition Co.

ELECTROCHEMISTS PLAN OCTOBER CONVENTION

THE FALL convention of The Electrochemical Society, to be held in Detroit, October 7–10, will be decidely "international" in character, as many Canadians are planning to participate in the scientific and technical sessions. Headquarters for the convention will be at the Hotel Statler.

Malcolm Dole of Northwestern University is in charge of the session on "Theoretical Electrochemistry." Eight manuscripts by outstanding scientists are already scheduled for this symposium. The second part of the session will be devoted to "Modern Trends in Electrodeposition", in charge of the Electrodeposition Division, Harold J. Read, chairman. The Round-Table discussion on modern plating problems is in charge of Gustaf Soderberg, the Udylite Corp., Detroit.

AMERICAN SOCIETY FOR TESTING MATERIALS ELECTS OFFICERS

AT ITS 45th annual meeting in Atlantic City, June 22–26, the American Society for Testing Materials elected H. J. Ball, Professor of Textile Engineering, Lowell Textile Institute, to succeed G. E. F. Lundell as president. P. H. Bates, chief, Clay and Silicate Products Division, National Bureau of Standards, was chosen vice president to serve with Dean Harvey, materials engineer, Engineering Laboratories and Standards Department, Westinghouse Electric & Mfg. Co., who was elected vice president in 1941.

Award of the 1942 Charles B. Dudley medal was made to F. C. Todd, assistant professor, Petroleum and Natural Gas Engineering and A. W. Gauger, director, Mineral Industries Research, Pennsylvania State College, for their paper presented at the 1941 annual meeting on "Studies on the Measurement of Water Vapor in Gases." This paper was considered an outstanding contribution to research in engineering materials.

CHICAGO CHEMICAL SHOW TO STRESS WAR-TIME PROBLEMS

IMPORTANCE OF pure and applied chemistry in the solution of many war-time problems will be stressed at the second biennial National Industrial Chemical Conference and Exposition to be held at the Sherman Hotel, Chicago, November 24-29.

Attendance at the show is expected to exceed more than 20,000 chemical

CALENDAR

SEPT. 7-11	American Chemical Society, 104th meeting, Buffalo, N. Y.
SEPT. 29-30	Technical Association of the Pulp and Paper Industry, Statler Hotel, Boston, Mass.
OCT. 7-10	The Electrochemical Society, fall meeting, Hotel Statler, Detroit, Mich.
NOV. 9-13	American Petroleum Institute, 23rd annual meeting, Palmer House, Chicago, Ill.
NOV. 16-18	American Institute of Chemical Engineers, 35th annual meeting, Netherland Plaza, Cincinnati, Ohio.

engineers, executives of industrial plants, research chemists, purchasing agents, government specialists and others identified with the chemical industry. It is reported that more than 75 percent of the available space, which is approximately twice as much as for the first exhibition in 1940, is already under contract. Prospective exhibitors are requested to communicate with Marcus W. Hinson, manager, National Chemical Exposition, 110 North Franklin St., Chicago, Ill.

PAINT CHEMISTS CANCEL MEETING

At its meeting in Chicago, July 10, the Executive Committee of the National Paint, Varnish and Lacquer Association voted to cancel arrangements for the annual convention of the association originally announced for Atlantic City, October 28-31. Cancellation of the meeting was voted in view of the transportation shortage, together with the selecting of certain Atlantic City hotels by the Federal Government for housing members of the armed forces. The association plans to develop a method for carrying on convention information by mail.

TECHNICAL MEETINGS NOW BEING SCHEDULED

Among the technical association meetings and conventions of interest to chemical engineers and industrial chemists now being planned for the fall months are the following:

American Chemical Society, 104th meeting, Buffalo, N. Y., Sept. 7–11.

American Institute of Electrical Engineers, Vancouver, B. C., Sept. 9–11.

National Petroleum Association, annual meeting, Hotel Traymore, Atlantic City, N. J., Sept. 16–18.

Technical Association of the Pulp and Paper Industry, Statler Hotel, Boston, Massachusetts, Sept. 29–30.

National Safety Congress and Exposition, 31st annual meeting, Stevens Hotel, Chicago, Ill., Oct. 5–9.

Electrochemical Society, fall meeting, Hotel Statler, Detroit, Mich., Oct. 7–10.

American Society of Mechanical Engineers, fall meeting, Rochester, N. Y., Oct. 12–14.

American Petroleum Institute, 23rd annual meeting, Palmer House, Chicago, Ill., Nov. 9–13.

American Institute of Chemical Engineers, 35th annual meeting, Netherland Plaza, Cincinnati, Ohio, Nov. 16–18.

National Chemical Exposition and National Industrial Chemical Conference, Sherman Hotel, Chicago, Ill., Nov. 24–29.

American Society of Mechanical Engineers, annual meeting, New York, N. Y., Nov. 30–Dec. 4.

American Institute of Mining & Metallurgical Engineers, annual meeting, New York, N. Y., Feb. 15–18, 1943.

SELECTIONS FROM CONVENTION PAPERS

PLACE OF INDUSTRIAL TECHNOLOGY IN THE WAR EFFORT

This country now knows that to fight a total war it must have a total war economy. This means that we must have the complete mobilization of our machinery, our man-power, our resources and our finances, and that we must make the fullest possible use of all these.

The Axis leaders have made a very serious miscalculation. They obviously believed that it was not possible for a great democracy to accomplish such complete industrial mobilization. Had they believed otherwise, they would not have thrust the war upon this country. It is now evident, however, that we are getting the complete mobilization and utilization of our resources and our energies which the Axis leaders thought impossible for us to accomplish.

This country needs and must have more engineers, civil, mechanical, electrical and chemical, not only to help speed up the war program but to aid with the great tasks which will be forced upon us when peace comes. We are going to need engineers to mobilize for peace with the same enthusiasm, energy and determination that we are mobilizing for war. The engineer, the technician, does not operate in a vacuum. He is a part of his own human society. Society will expect of him a devotion and a performance equal to its own.

The industrial technician and the production man can no longer think in terms of designing a product or arranging a production schedule in terms of what is the most profitable level of operation, or what combination of design, finish and material will make the most salable end-product. Instead, he must think in terms of getting the greatest volume of production physically possible from the plants and materials at hand. In some cases he must turn to what ordinarily would be considered highly uneconomic methods of doing a job. In redesigning a product or re-arranging a production process, he tries to save materials, machine-hours and labor, not in order to save expenses but to get a greater number of end-products made with a given set of mechanical equipment and a given amount of raw material. He learns anew that necessity is the mother of invention, that corners have to be cut, old routines re-examined, experimentation pushed to the very limit.

Donald M. Nelson, Chairman, War Production Board, Washington, D. C.

at a banquet dedicating the new Technological Institute of Northwestern University, Evanston, Ill., June 15, 1942.

FELDSPAR FOR EXTINGUISHING MAGNESIUM INCENDIARY BOMBS

FELDSPAR, ground to pass a 10-mesh screen and retained by a 200-mesh screen, has been found to be very effective in extinguishing magnesium incendiary bombs. Effectiveness of this material has been demonstrated on a small scale in the Geological Survey laboratories and on 1-lb. bombs at Edgewood Arsenal of the Chemical Warfare Service.

Fusing at about 2,100 deg. F., which is lower than the melting point of sand, feldspar quickly forms a protective coating over magnesium to cut off the supply of air. This stops burning of the magnesium and prevents spreading of the flame. Feldspar is superior to mixtures containing salt, pitch, ashes or fine powders, as it does not burn, give off smoke, blow out or scatter appreciably. In laboratory experiments, it was shown that when magnesium or an incendiary bomb was ignited and placed on a pine floor or board and then covered with ground feldspar, the fire was extinguished so quickly and the supply of oxygen was cut off so effectively that the wood was charred only to a depth of less than 0.5 in. Moreover, only about 50 percent of the magnesium was consumed in most tests with feldspar, the balance being put out before it burned.

It is essential that fine material of less than 200-mesh screen size can be eliminated, as this tends to clog interstices and prevent the ready escape of gases, which would then erupt with sufficient force to form miniature craters in the feldspar cover and thus destroy its effectiveness. Ground granite, consisting of about 65 percent potash and soda feldspars and 35 percent quartz and minor materials, should be better than ordinary sand but inferior to ground feldspar for extinguishing magnesium bombs.

Feldspar should not cost more than 50-75 cents per 100 lbs. wholesale when shipped in bulk to a central point in any of the large cities of the east coast. The retail price would be slightly higher. This 100 lbs. will fill two buckets, enough for the average small house. It is also readily available, being the most abundant constituent of a large variety of common rocks such as granite, syenite, pegmatite, etc. The material also has the advantage that it is easily handled. Its use does not require extensive equipment or the services of

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"If, as an engineer, you can by your skill contrive to save a single hour of a single worker's time, if you can save a single pound of steel, if you can find a good substitute for a single strategic material, if you can evolve workable short-cuts in conversion, if you can dig out old, idle machines and make them productive, then you are doing your share in winning the war."

trained crews. Once feldspar has been applied to burning magnesium (which can be done in a few seconds) the bomb requires no further attention. However, in addition to having feldspar to extinguish the magnesium bomb itself, there must be water available to combat fires started by flying sparks.

In order to protect the public interest and to prevent exploitation of the method, the Department of Interior, by arrangement with the inventors acting through the Department of Justice, has taken proper steps to obtain government controlled patent protection for the invention. Under the patent, the Department will make the process and use of the material available to any commercial concern. Commercial development of the material will be encouraged by the Department of the Interior, but government control of the patent will protect the public against price exploitation and extravagant and misleading advertising.

W. W. Rubey, geologist, Michael Fleischer and J. J. Fahey, chemists, U. S. Geological Survey, Department of the Interior, Washington, D. C.

CHEMICAL ENGINEERING ASPECTS OF CENTRIFUGAL FAN DESIGN

In general, repairs and maintenance of the fan in chemical service will be proportional to the speed of the impeller. Conclusions reached by the ventilating engineer should be reexamined when the chemical fan is being designed.

Impeller Proportions—Static pressure due to centrifugal action of the impeller varies as the difference of the squares of the rotational velocity and the periphery and inlet of the impeller blades. Hence, a fan having a low ratio of inlet to periphery radius will develop the greatest pressure at a given speed. In ventilating practice the usual fan has a ratio of inlet to periphery of about 0.625 since this gives an economical balance between investment cost and power cost. Under corrosive conditions it might be desirable to design with a lower inlet-periphery ratio even though this increases investment cost, since centrifugal force and power are both reduced. Although the fan of 0.350 ratio is considerably larger than the standard, the centrifugal force is only 30.5 percent as much. Decreased repairs and power might easily justify the increased size.

Impeller Blade Slope—Blades on the impeller can be straight radial blades as in the usual steel plate fan or can be sloped forward (in the direction of rotation) or backward. In ventilating practice the tendency has been to go toward backward sloping blades. For a given pressure and delivery, however, the backward sloped blade requires a higher speed. Accordingly, for corrosive conditions, it will often be desirable to use forward sloping blades and sacrifice certain advantages in order to decrease centrifugal force and hence repairs. If the problem is one of erosion, the use of the forward sloped blade may be detrimental. This is due to the higher

gas velocity at the tip of such a blade.

Cut-Off Point—The point where the scroll or spiral discontinues its approach to the circumference of the wheel is called the "cut-off point". In some fans, almost half the wheel will be exposed, whereas in others none of it will be visible when looking into the fan along the axis of discharge. At high pressures, design (b) in the accompanying drawing is preferable from the standpoint of reducing speed, whereas in low pressure, the reverse is true. Since most chemical fans are designed to operate in the higher pressure portion of the fan curve, design (b) is usually preferred.

Fan Inlet—Fans designed for ventilating service frequently have vanes installed in the fan inlets to direct the gas into the impeller in the direction of its motion. Such vanes usually increase the efficiency of the fan but necessitate higher speeds to maintain static pressure and capacity. Where low speed is vital, the vanes can be dispensed with at a slight sacrifice in power cost.

In installations where an elbow must connect into the inlet box of a fan, the effect is frequently similar to that of inlet vanes. The lowest speed for a given capacity and pressure is obtained by installing the elbow so that the rotation imparted to the flow of gas by the elbow is in an opposite direction to the rotation of the wheel. The best solution is to install vanes in the elbow so that straight line flow is maintained into the inlet. Under corrosive conditions this is not always feasible.

A fan with double inlets will attain a given capacity and pressure at a lower speed than the same fan with a single inlet. In spite of the higher installation cost, double inlets are preferred in most cases where centrifugal force is important. Where a large pipe is reduced down to the inlet of the fan, the most efficient connection is one in which the taper of the walls is about 7 deg. to the axis of the pipe. Any large deviation from this can seriously affect the speed at which the fan must operate

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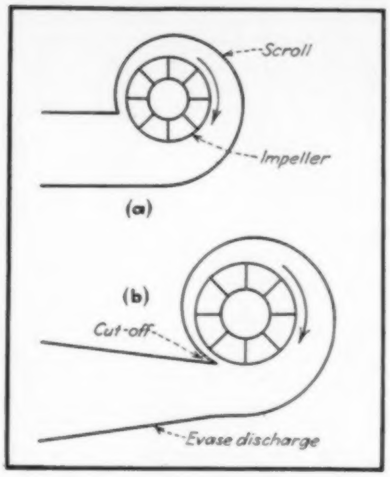
Estimated Synthetic Rubber Production—Long Tons[1]

	1942		
	Actual 1st half	Objective 2d half	Total
Buna S	1,000	7,000	8,000
Butyl	....	300	300
Neoprene	3,600	8,400	12,000
Buna N and thiokol	4,800	7,200	12,000
Total	9,400	22,900	32,300

	1943		
	1st half	2d half	Total
Buna S	54,600	226,400	281,000
Butyl	1,700	19,300	21,000
Neoprene	9,500	11,500	21,000
Buna N and thiokol	7,500	7,500	15,000
Total	73,300	264,700	338,000

[1] As submitted by Donald M. Nelson, chairman, War Production Board, to the United States Senate, July 14, 1942.



to maintain a given capacity and pressure.

Fan Outlet—In most fans, gases leaving the scroll have a high velocity and a high kinetic energy. It is desirable to convert as much of this as possible into static pressure. The usual means for accomplishing this is to fit the fan with an Evase discharge as shown in the accompanying figure. To obtain optimum results from this, the slope of the sides with respect to the axis should be less than 7 deg.

Carl V. Herrmann, chemical engineer, E. I. du Pont de Nemours & Co., Wilmington, Del., before the American Institute of Chemical Engineers, Boston, Mass., May 11-13, 1942.

THE CHEMICAL ENGINEER IN THE PRESENT WORLD CONFLICT

SOMEONE HAS said that World War I was a war of chemists and chemical engineers, but that its present-day successor is a war of physicists and mechanical engineers. Like other generalizations, this may be true in a rather limited, tactical sense, because today's fighting emphasis is most certainly on planes and tanks, ships and guns. But behind the lines, in the shops and factories, laboratories and arsenals, are the men and women who make up the production army, which is smaller and less spectacular but absolutely vital and essential.

Every man who has had technical training and experience faces the responsibility of deciding just how he can best use his particular abilities in the service of his country. All of us who are physically fit would probably prefer to join the ranks of the combat army. We are envious of our friends who have found their places in the armed forces. If they are chemical engineers, they are unusually fortunate if their assignments are in Ordnance, Chemical Warfare or other specialized services where their technical training can be of use. Unfortunately, these opportunities are relatively rare. For every technical man in the combat army serving in a technical capacity, there must be hundreds or thousands of soldiers and sailors whose greatest contribution is courage, strength and stamina.

This disparity in numbers between the production and combat armies is illustrated by Dean Frank C. Whitmore of Pennsylvania State College, who cites just two figures: 27,000,000 and 250,000. The first refers to the total number of men up to 35 years of age who have registered in the Selective Service System. The second number is slightly more than the total enrollment of the National Roster of Scientific and Specialized Personnel, which includes all the chemists and physicists, engineers, bacteriologists, geologists and other scientifically trained men from the graduating classes of 1942 up to 80 years of age. According to Whitmore, if we lose this war, it will be either because the quarter million is too small or because it has not been put to its most effective use in the war effort.

Of this quarter million, probably only 15,000-20,000 are chemical engineers. The fact that even during the worst days of the depression less than two percent of these were unemployed would seem to indicate that they are needed in normal peace-time operations. But now, with the tremendous expansion of chemical industries to meet war needs, the accelerated programs of war research and development, and with the new synthetic rubber, magnesium and other munition plants yet to get into full swing, some terrifying shortages of chemical manpower are certainly ahead. Hence it is vitally important that chemically-trained men should be discouraged from voluntary desertions from the ranks of essential industry and that any misconceptions regarding the relative importance of the combat versus the production army should be corrected. In addition, there is an important job to be done in educating employers as well as the personnel of local draft boards.

Various estimates have been given on the number of persons that must be employed behind the lines for each man in uniform. General Hershey stated last December that at least 14 workers were needed for every man in the army. To this must be added the number of behind-the-line workers needed for the planes, ships and tanks we are sending to Britain, Russia and China. This brings the total to probably 17 or 18. Chairman McConnell of the Engineers Defense Board holds that at least one of those 17 or 18 should be with technical training.

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Consumption of fertilizer during 1941 totaled 9,264,000 tons, the largest on record. It is now estimated that 15 percent of our total crop production is the direct result of fertilizer use. The average plant food content of mixed fertilizer in 1925 was only 16 percent. Now it is over 20 percent. This improvement has eliminated the handling, shipping, and application of 1,430,000 more tons of fertilizer material that otherwise would have been necessary.

This means that for every man in our armed forces there should be one technical man in industry. We have been told that by the end of the current year the country's total armed forces should be well in excess of 4,000,000 men.

This indicates that we have need for over 4,000,000 men and women with technical training. Yet the entire National Roster is less than a quarter of a million. We are trying to make up that deficit with greatly expanded and accelerated training courses in industry and in the universities. During the fiscal year which just ended, the U. S. Office of Education will have given instructions to 3,800,000 defense workers. Perhaps 200,000 of these are at the college level.

Nor should be overlook the impressive job that is being done by technical men in the Office of Scientific Research and Development under the direction of Dr. Vannevar Bush of Carnegie Institution. Their assignment is to coordinate and initiate research on all the "instrumentalities, methods and materials of war". During this fiscal year, O.S.R.D. will have spent about $20,000,000 and mobilized at least 3,500 American scientists and engineers. It has approved and set into motion approximately 600 no-profit, no-loss contracts, about two-thirds of which are in educational institutions and one-third with commercial firms. At least 75 schools and almost that many companies are involved. The various N.D.R.C. committees comprise about 500 scientists and engineers, and their contracts cover between 5,000-6,000 employees. Of these about one half are scientists and engineers. The exact nature of their work is the most carefully guarded of all war secrets.

The job of the chemical engineer in the present world conflict is to take the germ of a new idea of the research scientist and translate it into a functioning process, product or implement of war. We are up against enemies that have long recognized the dual role of technology in war as well as in peace. In order that we may again have the opportunity to put our chemical engineering technology into peaceful pursuits, we must first make an all-out engineering effort toward outstripping the war technology of our enemies.

S. D. Kirkpatrick, Editor, *Chemical & Metallurgical Engineering*, before the 50th annual meeting of the Chemical Engineering Conference, Society for Promotion of Engineering Education, New York, June 27-29, 1942.

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Nearly 200,000 persons worked in production activities in the petroleum and natural gas industries in 1939. Some 7,782 companies were engaged in the production of oil and gas and operated, at the end of 1939, some 300,179 oil and gas wells and 47,466 gas wells. Principal expenses included $168,382,732 paid direct for labor to an average 113,498 wage earners with $83,844,270 in salaries to 32,327 salaried employees.

A new world's safety record for the petroleum industry has been set by the more than 1,000 employees of the Wood River, Ill., refinery of the Standard Oil Co. of Indiana. The record is 6,850,000 man-hours of work without loss of time or disabling injury because of accident. For nearly four years the Wood River refinery workers have carried on their work day and night without a single disabling accident.

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FACTICE AS A RUBBER EXTENDER AND SUBSTITUTE

INCREASING interest is being shown in the subjects of rubber substitutes and of compounding materials. Among such materials is "factice," a product of the action of sulphur or sulphur chloride on vegetable. fish or other oils. Material of this kind has been used to some extent in the rubber industry.

Brown factice is made by treating the oil with sulphur at 160-200 deg. C. The soft kinds contain low sulphur from strongly-blown oils; harder varieties from raw oils contain up to 20 percent sulphur. White factice is derived from rape or colza oils by slow addition of sulphur chloride to the extent of 25 percent. Brown factice is used in hot-cured mixings, white in cold-cured. Erasing rubbers contain white factice; in some instances rubber is absent altogether. It is also used in rubber proofings, to which it imparts a characteristic smooth feel. Factice is sometimes used as an adulterant of reclaim and of gutta-percha.

Another form of factice is made by treating warm oil with a small quantity of flowers of sulphur and then completing the treatment with the chloride. This product has fairly good mechanical properties and is used in cut sheet. Factices are solid jellies, insoluble in rubber solvents. They disperse into very dilute gels and can be saponified by treatment with alkalis. Usually factice is regarded less as a substitute than as a definite compounding material introduced to improve aging and produce good effects in the mechanical working of stocks; it does not oxidize or become resinous.

Factice possesses to some degree the characteristic elastic properties of rubber and can therefore be incorporated in vulcanized rubber in large amounts. Tensile properties and abrasion resistance of rubber containing factice are, however, poorer than when factice is not used. Rubber goods containing factice cannot be used in contact with steam or hot water.

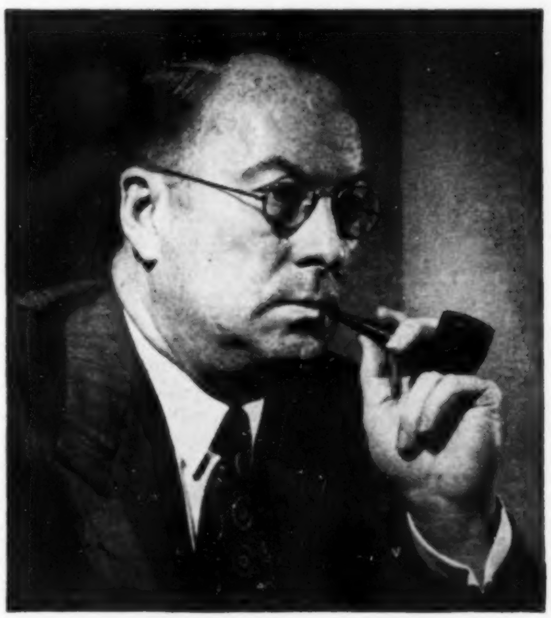
The National Research Council has made a compilation of abstracts of articles and patents on factice from the British Chemical Abstracts (1892-1940), the American Chemical Society's Abstracts (1907-1941), and selected books on rubber. This bibliography, published as *Bulletin 1054*, was prepared by the Research Plans and Publications Section.

Canadian Chemistry & Process Industries, Toronto, Canada, June, 1942.

Patriotic volunteer committees of executives are already hard at work on this problem in 421 industrial centers.

The Industrial Section of the Conservation Division has a corps of technical advisers who are prepared to work with all types of industries.

A thoroughgoing Salvage program in a factory can not only help meet the present emergency, but can help prepare that factory for its postwar operations through the elimination of once wasteful practices.



All unusable material, equipment, and stocks should be scrapped at once and put back into war production. Please read this message and act **now.**

D. M. NELSON, CHAIRMAN, WAR PRODUCTION BOARD

1 The first thing to do is to put some one individual in charge of Salvage in all departments of your business and give him not only the responsibility to act, but the authority to act.

2 The next thing to do is to get in touch with your local Industrial Salvage Committee and map out a detailed program with the materials and ideas that are available. Their program contains 17 simple steps.

If in any doubt, write or wire at once to the Conservation Division, War Production Board, Railroad Retirement Building, Washington, D. C.

This job is being tackled by a democratic nation through the volunteer efforts and initiative of democratically managed industrial concerns, rather than through directives or compulsion as it is done in Axis countries.

Every executive, every superintendent, every foreman and every worker in every plant can help.

The main thing is to get started now.

This message approved by Conservation Division

WAR PRODUCTION BOARD

This advertisement paid for by the American Industries Salvage Committee (representing and with funds provided by a group of leading industrial concerns).

SCRAP FROM HOMES AND FARMS—As individuals, search your home from attic to basement. Search your garage. Look at the old familiar things in a new light. Do you need them—or can you get along without them? Your country needs every pound of scrap iron and steel, other metals, rubber, rags and burlap to provide the fighting materials our armed forces must have. Take your scrap to the nearest Salvage Depot—give it to a charity—or sell it to a Junk dealer. . . . If you live on a farm, consult your County War Board or your farm implement dealer. In any case, your scrap will flow back into the blood stream of our war production.

SELECTIONS FROM FOREIGN LITERATURE

NICKEL PLATING

OPTIMUM conditions for smooth, bright, adherent nickel plating on iron include agitation by bubbling compressed air through the electrolyte, and maintenance of optimum current density. The beneficial effect of agitation is more marked at high than at low current densities. Cathode efficiency is low at low current densities because energy is expended largely in discharging hydrogen. Efficiency rises with the increasing hydrogen over-voltage at higher current densities but after the optimum is reached there is a drop in efficiency due to rapid depletion of metal in the cathode film and consequent evolution of hydrogen. Experimental data show the effects of electrolyte concentration, time, temperature, current density, distance between electrodes, agitation, superimposing a.c. on d.c., nature of cathode surface and addition of alcohols, glycerol, mannitol, sucrose and several inorganic products.

Digest from "Studies of Some Physical Factors in Electrodeposition of Nickel on Iron," by D. N. Solanki and D. Singh, *Journal of the Indian Chemical Society* **18**, 422-45, 1941. (Published in India.)

PYROLYSIS OF NITRILES

CATALYTIC cracking of long chain aliphatic nitriles has been investigated for commercial applications, but not with a background of research on fundamental principles. Non-catalytic thermal decomposition has therefore been studied with acetonitrile and propionitrile. The pyrolysis chamber was a silica tube, wound with a heating coil and suitably insulated. Pyrolysis of acetonitrile is a relatively simple reaction while that of propionitrile is complex. Acetonitrile at 675 deg. C. yields chiefly hydrogen, methane, hydrogen cyanide and small amounts of ethylene, acetylene and a liquid which is probably benzonitrile. There is also considerable formation of free carbon, presumably by cracking of the primary decomposition products. Apparently hydrogen cyanide is a primary decomposition product while free hydrogen results from secondary cracking. A kinetic study of acetonitrile and its pyrolysis at about 800 deg. C. is in progress.

Digest from "Note on the Pyrolysis of Ethyl and Methyl Cyanides," by B. S. Rabinovich and C. A. Winkler. *Canadian Journal of Research* **20B**, 69-72, 1942. (Published in Canada.)

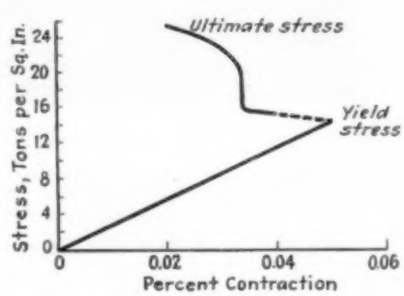
CARBONIZATION PRODUCTS

PYROLYSIS of organic materials such as cellulose, Bakelite, petroleum coke, anthracite and bituminous coal proceeds in two stages. In the first, extending up to about 600 deg., gaseous products are accompanied by liquids which vary widely in composition but carry the pyrolysis toward a common type of solid residue. Methane is prominent among the gases, with maximum emission between 500 and 600 deg. It has been demonstrated by fractional carbonization tests at intervals of 100 deg., and by x-ray powder photographs of the residue, that the original structure soon breaks down and that the carbon atoms are reoriented in a hexagonal graphitic network. This new structure in the solid residue is so stable that heat alone does not break it. In the second stage the volatile products are mainly gases with methane, hydrogen and carbon monoxide predominating. With particular reference to coal the results confirm the idea that there is a critical carbonization temperature, with a sharp increase in evolution of hydrogen at 700 to 800 deg. This behavior is not a special property of coal or of any constituent thereof but is apparently a normal feature of molecular condensation in solid residues formed at lower coking temperatures.

Digest from "Primary Gaseous Products of Condensation," by K. Bolton J. E. Cullingworth, B. P. Ghosh and John W. Cobb. *Journal of the Chemical Society* **1942**, 252-263. (Published in England.)

YIELD POINT IN METALS

A SET of atomic planes spaced practically perpendicular to the stress direction in a steel test piece should contract with the cross section as the test piece is elongated. It has been found that this expectation is met until the external yield point is reached. Then the lattice spacing suddenly expands instead of continuing to contract. As more stress is applied the lattice dimensions remain approximately constant in the expanded state, even after the load is released. The yield point of the atomic lattice in a metal is the outward sign that permanent lattice strains have been set up. These unexpected strains have a direct technical significance in relation to the mechanical properties of metals.



Digest from "Stress-Strain Curve for the Atomic Lattice of Mild Steel and the Physical Significance of the Yield Point of a Metal," by S. L. Smith and W. A. Wood, *Proceedings of the Royal Society* **179A**, 450-60, 1942. (Published in England.)

DIELECTRIC PROPERTIES OF RESINS

THE DIELECTRIC behavior of crystalline and non-crystalline solids has proved that molecules in solids are not always so rigidly fixed that they are incapable of any motion beyond thermal oscillation about a fixed equilibrium position. They are sometimes capable of orientational rotation, subject to

space limitations. In large complex molecules it is not uncommon for atomic groups (held by single valence bonds) to make orienting rotations while the molecule as a whole is fixed. Such is the case in phenoplasts, in which residual unreacted hydroxyl groups have considerable mobility and are responsible for a substantial part of the dielectric loss. In commercial phenoplasts residual electrolyte (condensing agent) is a frequent cause of high dielectric loss (less so in cresolic than in phenolic resins). The loss factor which persists after thoroughly leaching out the electrolyte is small at low temperatures but becomes large at high temperatures since heat increases the mobility of rotating atomic groups. To overcome this cause of dielectric loss the orientational capacity of the hydroxyl groups must be destroyed or the hydroxyl groups must be replaced by less mobile substituents. The latter expedient is feasible and has given good results when care was taken in making phenoplasts to minimize the retention of free (unsubstituted) hydroxyl groups in the resin molecule.

Digest from "Research on Phenoplasts Dielectric Properties," by H. Stäger, W. Siegfried and R. Sanger, *Schweizer Archiv fur angewandte Wissenschaft und Technik* 7, 201-8, 1941. (Published in Switzerland.)

ELECTROPHORETIC DEPOSITION OF COLLOIDS

In measuring the cataphoretic speed of colloids, as in processes involving electrophoresis, the moving boundary method has some advantages over the transport method. To check the accuracy of Mukherjee's adaptation of the moving boundary method comparative tests were made with hydrosols of ferric and aluminum oxides. Three cases are distinguished, namely those in which the electrolyte content is high (cataphoretic and electrolytic conductivities comparable) and low (cataphoretic conductivity predominating). In the first case the moving boundary method has been checked against microscopic methods; it was shown by confirmatory tests to be accurate within 2 percent in the second case. This is approximately the accuracy of the transport method also. The third case is yet to be tested.

Digest from "On the Moving Boundary Methods for Determination of Cataphoretic Speed of Colloids," by N. C. Sen Gupta and P. R. Sinha, *Journal of the Indian Chemical Society* 18, 489-502, 1941. (Published in India.)

WATERGLASS SOLUTIONS

Commercial sodium silicate solutions, in which the $Na_2O:SiO_2$ ratio may range from 1:1 to 1:4, have colloidal properties and yet they have the high electrical conductivity and osmotic activity of electrolyte solutions. No sharp breaks in physical properties can be detected to indicate the formation of any definite compound. Presence of colloidal matter in waterglass solutions has been demonstrated by ultramicroscopy and by diffusion measurements. A more intensive study of diffusion behavior was therefore made in search of more information concerning the

colloidal and electrolytic nature of sodium silicates in solution. The new evidence shows that the variable waterglass solutions in commercial use are nothing but the orthosilicate, Na_4SiO_4, or its acid (dihydrogen) salt, $Na_2H_2SiO_4$, mixed with from 1 to 3 moles of colloidal hydrated silica, SiO_2H_2O. The hydrated silica may vary in fractions of molar ratios since it is not in direct chemical combination with the sodium silicate. This explains why physical properties of waterglass solutions do not have sharp transitions from one composition to another.

Digest from "On the Constitution of Sodium Silicate Solutions," by R. C. Ray, P. B. Ganguly and A. B. Lal, *Transactions of the Faraday Society* **38**, 108-8, 1942. (Published in England.)

NICKEL AND COPPER IN BITUMENS

CRUDE oil always contains traces of nickel and copper. Analysis of numerous crudes showed 2.1 to 43 p.p.m. Asphalts contain more, ranging from 41 to 421 p.p.m. In one sample of asphalt the ash was 11.84 percent nickel. Unlike vanadium, nickel apparently exerts no catalytic influence on the naturally occurring reactions of petroleum hydrocarbons. The solubility of vanadium sulphide in bitumens increases faster than that of nickel sulphide as the temperature rises. Hence there is more nickel than vanadium in bitumens formed at low temperatures while the high temperature asphalts contain more vanadium than nickel.

Copper is apparently always present in crude oils but the content may be as low as 0.4 p.p.m. Asphalts usually contain more than crude oils, but they are poorer in copper than in nickel. A remarkable exception is a San Rafael asphalt containing 1,660 p.p.m. This high copper content probably resulted from contact with cupriferous ground water. It is possible that copper sulphide promotes the catalytic activity of vanadium sulphide in asphalt formation.

Digest from "Nickel and Copper in Bitumens", by G. A. Fester and J. Cruellas, *Anales de la asociacion quimica argentina* **30**, 34-5, 1942. (Published in Argentina.)

HARD ALLOYS

MODERN hard alloys are far superior to high speed tool steel for drilling, turning, grinding and polishing hard substances. They can even be used successfully on glass. There are two principal types. Both contain tungsten carbide and 6 percent cobalt, but one type has 15 percent of titanium carbide added. These alloys have a compressive strength of about 42,500 atm. or higher as against 30,000 to 40,000 atm. for hardened tool steel. Most important of all, the temperature at which they lose grinding efficiency by adhesion of the metal being ground is from 625 to 850 deg. C. as against 575 deg. C. for tool steel. Their high resistance to corrosion and abrasion makes these alloys exceptionally useful for sandblast nozzles, valve parts and

nozzles for coal dust burner equipment, and diamond drills for deep well drilling. The alloys are tougher than diamond crystals for facing drill bits, hence less subject to fracture under impact.

Digest from "Hard Alloys," by Walther Dawihl, *Chemiker-Zeitung* **65**, 146-8, 1941. (Published in Germany.)

X-RAY TUBES FOR SPECTROSCOPY

IN X-RAY spectroscopic examination of materials the great savings in time and effort are sometimes partly lost by unsatisfactory performance of the tube. The principal source of difficulty is in examining substances which evolve gases under cathode ray bombardment. Liberation of gas interferes with maintaining a high vacuum in the tube. Loss of vacuum causes the hot cathode (tungsten wire) to lose tungsten atoms by sputtering and the tungsten atoms deposit on the anticathode, thereby interfering with proper tube performance. To prevent sputtering of the hot cathode a new tube has been devised in which the filament and anticathode are 20 cm. apart instead of about 2 cm. as in ordinary tubes, so that sputtering of tungsten on the target is only about 1/100 as great. The new tube has combined electric and magnetic focussing so that most of the cathode rays reach the anticathode in spite of the 20 cm. distance from the hot filament. Electric prefocussing is accomplished with an electric lens, which also takes up all the high tension. Thus the tube works very steadily even at very high tensions (up to 100 kv).

Digest from "X-Ray Tubes for Spectroscopic Purposes," by Manne Siegbahn, *Arkiv for Matematik, Astronomi och Fysik* **28B**, No. 4, 1-4, 1942. (Published in Sweden.)

STRAW FOR PAPER AND RAYON

PULPING of cereal straws has been greatly improved by introduction of the two-stage bleach. The serious loss of mechanical strength formerly incurred in commercial bleaching of straw sulphate pulps is now almost completely avoided, so that straw pulp becomes a candidate for uses from which it was formerly barred. The new bleach involves pretreatment with free chlorine and an intermediate washing with aqueous alkali before the final hypochlorite bleach. Another major advance in making straw sulphate pulp eligible for use in making rayon cellulose is in replacing alkaline by acid mediums in low temperature refining of the bleached pulp. The object is to remove pentosans, which must be almost entirely eliminated from rayon cellulose. By changing the process sequence so that acid treatment precedes alkali digestion a profitable yield of furfural can be obtained from straw. The optimum medium for acid treatment is within a very narrow range of sulphuric acid concentration.

Digest from "Straw as a Raw Material for Making Paper and Rayon Pulps," by G. Jayme, *Chemiker-Zeitung* **65**, 30-31, 1942. (Published in Germany.)

New Titles, Editions and Authors

CHEM & MET BOOKSHELF

MUSTARD, LEWISITE, ET AL.

WAR GASES: THEIR IDENTIFICATION AND DECONTAMINATION. By *Morris B. Jacobs*. Published by Interscience Publishers, Inc., New York, N. Y. 180 pages. Price $3.

AMONG the aims of this book are those of presenting under one cover the most recent information from the literature on all the various aspects of identification and decontamination of chemical warfare gases, and of summarizing this information in a form that will be most useful to gas identification officers, decontamination squads, health officers, as well as to war gas chemists. The author has succeeded very well in accomplishing both these objectives.

Numerous tables serve to crystallize the information and to make the data more valuable for quick reference. The subject matter has been well organized and sub-divided by the liberal use of cross-page and marginal headings. In addition, the author has included numerous general as well as specific literature references. These show that he has done a thorough job of covering the best American, British and German sources, including the little-known government publications of this country and of Great Britain.

Included are chapters on the various classifications of chemical warfare agents, physical characteristics, physiological action of types and of individual gases, effects on various materials such as metals, textiles, water, foods and livestock, methods of sampling, scheme of analysis by physical and physiological tests as well as by field and laboratory chemical methods, detection and determination of arsenic, confirmatory tests according to chemical constituents, decontamination methods, and protection of foods. The author does not go into the subjects of first-aid treatment of gas casualties, tactical uses, or protective measures such as gas masks, clothing and gas-proof shelters.

Although the paper used is not up to the usual American book-type quality, both printing and binding are well done. The book will undoubtedly serve as a valuable reference on the detection, sampling and identification of war gases.

PLATING SYMPOSIUM

MODERN ELECTROPLATING. Published by The Electrochemical Society, New York, N. Y. 400 pages. Price $5.50.

VARIOUS chapters in this volume were originally a group of papers composing a symposium held during the meeting of the Electrochemical Society at Chicago, Ill., October, 1941. The entire discussion that accompanied the presentation of the papers is presented for a clear understanding of the viewpoint of those actively engaged in electroplating, but with the verbal presentation necessarily abstracted for brevity.

The symposium opens with a discussion of the general principles and methods of electroplating. The authors present the most modern and accepted methods for the operation of a plating bath and discuss at length maintenance and control of the baths, and the determination of the physical and chemical qualifications of the deposits intended for one or other general or specific use. The theories underlying the various phenomena met with in electroplating are discussed and interpreted at length.

This general discussion is followed by a collection of papers in each of which the present status of electroplating with a specific metal is summarized. The metals covered include cadmium, chromium, cobalt, gold, iron, lead, nickel, silver and those of the platinum group. Copper is treated in three sections (1) the high efficiency cyanide copper bath; (2) acid copper electroplating and electroforming; and (3) rochelle copper plating. Tin is covered in chapters dealing with acid and alkaline solutions. Plating zinc from both acid and cyanide baths is discussed. And, of course, alloy plating comes in for its share of attention.

A unique feature of this volume is the abstract of each chapter appearing in Spanish.

Each chapter has been prepared by one or more of the foremost authorities in the field. To the 26 experts who have contributed to the volume, most of the credit goes for elevating electroplating to its present scientific plane. Every operator in an electroplating plant and every student will find this book well worth having on his bookshelf.

No. 1 IN THE R-SERIES

RATIONED RUBBER—WHAT TO DO ABOUT IT? By *Williams Haynes and Ernst A. Hauser*. Published by Alfred Knopf, New York. 181 pages. Price $1.75.

Reviewed by *S. D. Kirkpatrick*.

TO THE layman the greatest mystery of Science—and his keenest disappointment right now—is that our vaunted chemical industries can't supply him with tires of synthetic rubber made overnight from coal, air and water. He has been misled by the advertisements in the magazines and the commercials over the radio. He suspects that the politicians have probably messed things up a bit, but he still has hopes that somehow one of the "Miracles of Man-Made Materials" will turn up in time to save the situation.

So the famous chemical chronicler, in association with one of M.I.T.'s most resourceful researchers, sets out in this little book to answer all of the questions for John Q. Citizen. They do a pretty good job. The only trouble is that most of the folks who can really appreciate this semi-technical presentation of the facts are already fairly familiar with the situation. They have watched it closely through its various stages of development and are not going to be easily satisfied with anything written three months ago—no matter how accurate it was then.

The sections of this little book on rubber from the laboratories and the synthetic supplies of the future suffer seriously because of the time element. So quickly has the situation changed that the statistics are obsolete almost before a book can be published. Farm-bloc politics cannot alter the fundamental economic principles, but they can play havoc with well-laid plans of the petroleum people. And despite our slightly derogatory references to the man-made miracles, research hasn't been standing still since May 4, when the author's addressed their alarming preference to the "Attention, Citizens of America."

The great value of this little book lies in the way the authors have brought together so much information on rubber and presented it so interestingly and in such brief fashion. It will provide a lot of good material for discussions and arguments this summer and next winter when people's patience as well as their tires will have worn pretty thin.

ATOMISTICS AND THERMODYNAMICS

A TREATISE ON PHYSICAL CHEMISTRY. Vol. I. Third edition. Edited by *Hugh S. Taylor* and *Samuel Glasstone*. Published by D. Van Nostrand Co., New York, N. Y. 679 pages. Price $7.50. ($6.50 when ordered as part of complete set.)

IN PREPARING the revision of this well-known reference, the decision was reached to publish five volumes instead of two. The first, recently published, is titled "Atomistics and Thermodynamics." The book's four chapters are: "The Atomic Concept of Matter" written by Taylor, "Quantum Theory of Atomic Spectra" by Saul Dushman, "The First and Second Laws of Thermodynamics" also by Taylor, and "The Third Law of Thermodynamics and Statistical Mechanics" by J. G. Aston.

For a number of years Professor Taylor's "Treatise" has been a standard reference for students and workers in the field of physical chemistry. Although comparatively little of the material in the second edition of that book is outdated, there have been significant

advances since it was published. This observation would appear to be substantiated by the number of comparatively recent dates on the numerous footnote references in the text as well as by the decision to publish the treatise in three more volumes than its previous edition. The finished job will probably come very close to the editor's expressed hope that "a student in a special field could garner from its pages that which was known as he set forth in his quest for the unknown."

THE TECHNOLOGY OF NATURAL RESINS. By *C. L. Mantell, C. W. Kopf, J. L. Curtis* and *E. M. Rogers.* Published by John Wiley & Sons, New York, N. Y. 506 pages. Price $7.

Reviewed by *A. F. Schmutzler*

As CAN be expected from the authors, who are engaged as experts by the American Gum Importers, their detailed description is founded upon extensive research experience in the field of the imported natural resins, such as accroides, congo, domar, the east indias, elemi, kauri, the manilas, mastic and sandarac. The book does not include Canada balsam, gum thus, rosin or shellac; but in spite of these omissions, it contains valuable information about the first mentioned resins, much of which was published before in technological magazines and pamphlets of the American Gum Importers. It is convenient that all these publications are arranged in one book to serve as reference volume for varnish technologists. In many instances the information is substantiated by methods leading to the results.

The first chapter deals with the origin of the imported natural resins, their collection, initial purification and grading, followed by descriptions of physical and chemical properties of the individual resins, whose constituents are listed in tables showing their formulas and approximate percentage.

The importance of the natural resins depends upon their solubility and many, if not all, of the more recent commercially available solvents have been investigated. The products require purification before they can be used in varnishes or lacquers. The preliminary treatment consists either of a dry method or solvent extraction purification. The two types are supplemented by flow-sheets. Lacquers can be made directly from the cleaned product, while varnish making requires an additional thermal treatment called "gum running" which makes the natural resin compatible with drying oils. The temperatures of this process vary with the type of resin and directions are given for the most suitable procedures.

Modifications of the natural resins yield products with improved properties. Methods of making resin esters and modified alkyd and phenolic resins are illustrated and their effects in surface coatings are enumerated. The authors are to be commended for their unprejudiced comparison of natural resins with synthetic resinous ma-

terials, to the benefit of varnish technologists who will find a good starting point from the authors' conclusions. Formulations of lacquers and varnishes are accompanied by methods of preparation. Chlorinated rubber, cellulose ethers and esters are compatible with a number of natural resins, and the formulations and tables from the literature of the Hercules Powder Co. serve as convenient reference.

Table XXII, p. 134, makes it necessary that the reader be familiar with the Gardner-Holdt scale, as it lacks correlation between this scale and numerical equivalent values in poises. The set of compatibility of cellulose esters with damar and elemi, p. 163, are merely of a general nature, as they are hard to read and data which should accompany such an illustration are lacking.

Natural resins are used in paints, enamels, printing inks, emulsions, etc. and their significance in surface coating is demonstrated.

Though the book is more of a reference volume, it can be recommended as one of the textbooks for courses on resins, varnishes and surface coatings. For this purpose it would be necessary for the instructor to point out the items of interest for the particular courses. The authors treated the natural resins and their uses very well, but for any of the above-mentioned courses, this book would have to be supplemented by other literature.

ANALYTICAL CHEMISTRY. Vol. II, Quantitative Analysis. Ninth edition. By *F. P. Treadwell* and *William T. Hall*. Published by John Wiley & Sons, New York, N. Y. 806 pages. Price $6.

IT HARDLY seems necessary to prepare for *Chem. & Met.* readers a critical review of a book which has been used as a text and reference in this country for nearly 40 years. It should be sufficient to announce that another new edition is available. Many changes have been made in it, the author says, but the size of the book remains the same since old material was dropped to make way for new. There has been a rearrangement of methods to correspond to the usual order of qualitative detection as found in Vol. I.

INDUSTRIAL CHEMISTRY OF COLLOIDAL AND AMORPHOUS MATERIALS. By *W. K. Lewis, Lombard Squires* and *Geoffrey Broughton*. Published by The Macmillan Co., New York, N. Y. 540 pages. Price $5.50.

COLLEGE courses in physical chemistry, because of the broadness of the field, usually do not devote much time to consideration of the chemistry of colloidal and amorphous materials. Approximately one-half of this textbook, therefore, is devoted to basic material in which, as the authors point out, the usual graduate has an inadequate background although it is in the field of physical chemistry. Phenomena of vis-

cosity, surface tension, adsorption and gelation are studied. There are also chapters on suspensoids, emulsoids, electrochemical behavior of colloids, emulsions and foams. The material is well-written and is presented in a straightforward manner which will be readily comprehended by the student.

It is the second half of the book, however, which will probably be of greatest interest to practicing chemical engineers. In it the authors discuss the glass, paper, leather, rubber, liquid adhesives, protective coatings and ceramic industries as well as those dealing with plastic fibers, textile fibers, and synthetic resins and plastics. Each chapter is a brief treatise on a particular industry or group giving modern operational procedure as well as most recent applicable theories. The book can be recommended as a text, collateral reading or as a reference.

RECENT BOOKS and PAMPHLETS

Preventing Cutting and Welding Fires. Published by National Fire Protection Association, Boston, Mass. 16 pages. Price 10 cents. An illustrated booklet describing spectacular fires caused by sparks from cutting and welding operations and giving suggestions and rules for safe operating procedure.

The Aromatic Amino and Nitro Compounds, Their Toxicity and Potential Dangers. By *W. F. von Oettingen.* Public Health Bulletin No. 271. Available from Superintendent of Documents, Washington, D. C. 221 pages. Price 25 cents. A review of the literature of compounds which are of great importance in the dye and explosives industries. The study is not restricted to those aromatic amino and nitro compounds which are of immediate practical importance, but other compounds are also discussed which will allow appraisal of toxicity and potential dangers.

Electromagnetic Spectrum Chart. Available from Publications Section, 6-N-17, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Price $2. A 30x40-in. chart, printed in seven colors and showing the entire electromagnetic spectrum from a wave length of 3×10^{7} to 3×10^{-17} meters. The photographic and other spectrums of practical importance are analyzed in detail with emphasis placed on uses.

Arranging Shifts for Maximum Production. Published by the U. S. Department of Labor, Division of Labor Standards, Washington, D. C. 8 pages. This little booklet contains a discussion of the problem of multiple-shift production. A three-shift plan is offered to minimize disruption of family life.

Plastics From Agricultural Materials. By. *O. R. Sweeney* and *L. K. Arnold.* Iowa State Engineering Experiment Station Bulletin 154, Iowa State College, Ames, Iowa. 52 pages. Gratis. Soybean meal, corn cobs, and corn stalks—raw materials from 3 to 6¢ per lb.—were used to produce plastic materials which show definite commercial possibilities. Booklet gives experimental procedure and results.

A Manual for Explosives Laboratories. By *G. D. Clift* and *B. D. Fedoroff.* Published by Lefax, Inc., Philadelphia, Pa. A collection of Lefax loose-leaf sheets. Gives specifications and methods of test for various explosives and the raw materials which enter into their manufacture. Price for second edition is $2.

14,000 Gear Ratios. By *R. M. Page.* Published by the Industrial Press, New York, N. Y. 404 pages. Price $5. A book of tabulated gear ratios to facilitate solving any type of gear ratio problem likely to arise.

Plant Efficiency. Published by Division of Information. Office for Emergency Management, Washington, D. C.

Contains ideas and suggestions on increasing efficiency in smaller plants. Lighting, accidents, maintenance, training, plant protection and other important considerations for small plants or for plants which are just getting into war production, are discussed in simple terms to help increase production by a study of efficiency procedures.

Technique of Plywood. By *C. B. Norris.* Published by I. F. Laucks, Seattle, Wash. Price $2.50. Incorporates the 30 chapters on plywood which appeared originally in *Hardwood Record.* The articles cover various phases of plywood manufacture and are written from a technical standpoint for engineers, designers and users of plywood.

Laboratory Manual to Elementary General Chemistry. By *John C. Hogg* and *C. L. Bickel.* Published by D. Van Nostrand Co., New York, N. Y. 283 pages. Price $1.60. A laboratory manual prepared as companion volume to the authors' "Elementary General Chemistry." Of high school caliber.

Definitions of Electrical Terms. Sponsored by American Institute of Electrical Engineers, New York, N. Y. 311 pages. Price $1. Terms are arranged in various groups and subsidiary sections in the field of electrical engineering. Electrochemistry and electrometallurgy have a section of 20 pages in which the terms used in these sciences are defined. Both theory and practice are represented in the listing which is very complete.

Collateral Reading in Inorganic Chemistry. Second Series. Edited by *L. A. Goldblatt.* Published by D. Appleton-Century Co., New York, N. Y. 198 pages. Price $1.40. The readings are reprints of recent articles from scientific and technical magazines. The method of reproduction presents the various articles substantially as published. Use of this book by students for outside reading would give an early and desirable acquaintance with the magazines of current importance.

Trade and Professional Associations of the United States. By *C. J. Judkins.* Published by the United States Department of Commerce. Available from Superintendent of Documents, Washington, D. C. 324 pages. Price 70 cents. A list of 2,800 associations giving name, address, year formed, chief executive, number of members, number of staff and principal activities. Supplemental breakdown include a cities index, secretaries index, and commodities index.

Machine Tools at Work. By *C. O. Herb.* Published by The Industrial Press, New York, N. Y. 552 pages. Price $4. Contains more than 400 illustrations of actual examples of numerous different types of machine tools in use. Accompanying descriptions will aid machinists and shop foremen in acquainting themselves with advanced methods as well as fundamental principles.

Aircraft Riveting. By *E. B. Lear* and *J. E. Dillon.* Published by Pitman Publishing Corp., New York, N. Y. 118 pages. Price $1.25. A guide for students. Covers types of rivets and materials, riveting tools and methods, includes a glossary of shop terms.

Aircraft Engine & Metal Finishes. By *M. A. Coler.* Published by Pitman Publishing Corp., New York, N. Y. 128 pages. Price $1.50. A review of finishing techniques with particular emphasis on airplane engines. Contains six chapters which discuss purposes of engine finishing, nature of organic finishes, metal preparation, preparing organic finishes, application, and finishing systems.

Engineer's Pocket Book of Tables, Formulae and Memoranda. By *F. J. Camm.* Published by Chemical Publishing Co., Brooklyn, N. Y. 492 pages. Price $4.25. This is a collection of tables of British origin, which may be found useful by mechanics and machinists. They are largely concerned with such machine shop operations as screw cutting, milling, and boring. There are many tables of terms, and conversion data as well as lists of dimensions for gears, tapers, keys, shafts, drills and so forth. The typography is poor and the price is high.

Industrial Camouflage Manual. By *Konrad F. Wittmann.* Published by Reinhold Publishing Corp., New York, N. Y. 128 pages. Price $4. An illustrated publication describing activities of faculty and students at Pratt Institute in connection with the school's camouflage course.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, express order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

Beneficiation of Oxide Manganese Ores from Las Vegas Wash, Nevada, by S. R. Zimmerley, C. H. Schack, and F. E. Thackwell. Manganese Investigations—Metallurgical Division. No. 16. Ore-Dressing Studies of Manganese Ores. Bureau of Mines, Report of Investigations 3647. Mimeographed.

Correlation of Certain Properties of Oil-Well Drilling-Mud Fluids with Particle-Size Distribution, by George L. Gates and C. P. Bowie. Bureau of Mines, Report of Investigations 3645. Mimeographed.

Expansion of Coal During Coking, by James T. McCartney and Joseph D. Davis. Bureau of Mines, Report of Investigations 3644. Mimeographed.

Effects of Carbonaceous Blasting Accessories on Gaseous Products from Explosives, by John C. Holtz and E. J. Murphy. Bureau of Mines, Report of Investigations 3641. Mimeographed.

Determination by the Dropping-Mercury-Electrode Procedure of Lead, Cadmium, and Zinc in Samples Collected in Industrial-Hygiene Studies, by Florence L. Feicht, H. H. Schrenk, and Carlton E. Brown. Bureau of Mines, Report of Investigations 3639. Mimeographed.

Concentration of Manganese-Bearing Ore from the Bynum Property, Walnut Grove, Ala., by T. L. Johnston, M. M. Fine, and S. M. Shelton. Manganese Investigations — Metallurgical Division. No. 11. Ore-Dressing Studies of Manganese Ores. Bureau of Mines, Report of Investigations 3637. Mimeographed.

Dry Differential Grinding Tests of Carnotite Ores, by S. M. Shelton and A. L. Engel. No. 55 of Progress Reports—Metallurgical Division. Bureau of Mines, Report of Investigations 3636. Mimeographed.

Pointers on the Storage of Coal, by J. F. Barkley. Bureau of Mines, Information Circular 7211. Mimeographed.

Standard Methods for Measuring Extent of Atmospheric Pollution, by Carlton E. Brown and H. H. Schrenk. Bureau of Mines, Information Circular 7210. Mimeographed.

The National Lime Association Safety Competition of 1941, by T. D. Lawrence and J. E. Isaacson. Bureau of Mines, H.S.S. No. 299. Mimeographed.

Photomicroscopy of Salt in Petroleum, by Lloyd F. Christianson and J. W. Horne. Bureau of Mines, Technical Paper 638. Price, 25 cents.

Self-Contained Oxygen Breathing Apparatus, by G. W. Grove. Bureau of Mines. Price, 35 cents. A handbook for miners.

Water Permeability of Wall-Built Masonry Units. Bureau of Standards. Building Materials and Structures Report No. 82. Price, 20 cents.

Artists' Oil Paints. Bureau of Standards. Commercial Standard CS98-42. Price, 5 cents.

Hours and Earnings in the United States, 1932-40, with Supplement for 1941. Bureau of Labor Statistics, Bulletin No. 697. Price, 25 cents.

Vegetable Seed Treatment. By R. J. Haskell and S. P. Doolittle. Department of Agriculture, Farmers Bulletin No. 1862. Price, 5 cents.

Evaluation of Baits and Bait Ingredients Used in Grasshopper Control. By Robert L. Shotwell. Department of Agriculture, Technical Bulletin 793T. Price, 15 cents.

Technical and Economic Study of Drying Lignite and Subbituminous Coal by the Fleissner Process. By L. C. Harrington, V. F. Parry and Arthur Koth. Bureau of Mines, Technical Paper 633. Price 20 cents.

Design of Air-Blast Meter and Calibrating Equipment. By A. T. Ireland. Bureau of Mines, Technical Paper 635. Price, 10 cents.

Permissible Methane Detectors. By L. C. Ilsley and A. B. Hooker. Bureau of Mines, Report of Investigations 3643; mimeographed.

Quicksilver Deposits of the Opalite District, Malheur County, Oregon, and Humboldt County, Nevada, by Robert G. Yates. Geological Survey, Bulletin 931-N. Price, 60 cents.

Manganese Deposits in the Nevada District, White Pine County, Nevada, by Ralph J. Roberts. Geological Survey, Bulletin 931-M. Price, 25 cents.

Selenium Content and Chemical Analyses. Part 9 of Geology and Biology of North Atlantic Deep-Sea Cores, by Glen Edgington and H. G. Byers. Geological Survey, Professional Paper 196-F. Price, 15 cents.

Mineral Industry of Alaska in 1940, by Philip S. Smith. Geological Survey, Bulletin 933-A. Price, 35 cents.

Statistical Abstract of the United States, 1941. Bureau of the Census. 1,056 pages. Price, $1.50.

Electric Construction Budgets and Scheduled Additions to Generating Capacity 1942. Federal Power Commission. Price, 10 cents.

A Compilation of the Vitamin Values of Foods in Relation to Processing and Other Variants, by Lela E. Booher, Eva R. Hartzler, and Elizabeth M. Hewston. Department of Agriculture, Circular No. 638. Price, 25 cents.

Flaxseed Production in the North Central States, by A. C. Dillman, and T. E. Stoa. Department of Agriculture, Farmers Bulletin No. 1747. Price, 10 cents.

Measurement of Evaporation from Land and Water Surfaces, by C. W. Thornthwaite, and Benjamin Holzman. Department of Agriculture, Technical Bulletin No. 817. Price, 20 cents.

Utilization of Farm Crops; Industrial Alcohol and Synthetic Rubber. Hearings on Senate Resolution 224. Part 1. Price, 55 cents.

Parity Prices, What They Are and How They Are Calculated. Bureau of Agricultural Economics, Dept. of Agriculture. Mimeographed.

Patent Hearing. Hearings before the Committee on Patents, United States Senate. 77th Congress, 2nd Session on S. 2303. Part I. Price, 70 cents. A bill to provide for the use of patents in the interest of national defense or the prosecution of the war, and for other purposes.

Better Cities, by Charles S. Ascher. National Resources Planning Board.

Regulations prescribed by the Secretary of War and the Secretary of the Navy, with the approval of the President, governing the issuance of necessity certificates under Section 124 (f) of the Internal Revenue Code. Bureau of Internal Revenue. Mimeographed.

Effects of the War on British Marketing, by E. R. Hawkins. Bureau of Foreign and Domestic Commerce, Economic Series No. 18. Price, 15 cents.

Field Inspectors' Check List for Building Construction. Bureau of Standards, Building Materials and Structures Report BMS81. Price, 20 cents.

Statistics of Income for 1940, Part 1. Preliminary Report. Bureau of Internal Revenue. Price, 10 cents.

Emergency Specifications. Many additional revisions of government specifications have been completed recently modifying requirements for government purchases to conserve scarce materials or simplify war-time supplies for the government. During June, a long list of revised paper specifications was published. Also announced was a list of cement specifications and a list of wood preservatives specifications. Those interested in these specifications should identify the commodity of interest and request the "Emergency Alternate Federal Specifications" from Federal Catalog Division, Procurement Division Building, Washington, D. C.

Federal Specifications. A new Federal Specification has recently been issued: TT-P-115. Paint; Traffic, Exterior. White and Yellow, at the price of 5 cents.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 2223-B11—20-page booklet dealing with the line of rotary positive blowers put out by this concern. Discusses in detail and illustrates advantages of the positive displacement type, operating principles and characteristic curves, design and construction features, accessories, and uses in sewage and water works plants, chemical process industries, mining and smelting, oil refining processes, and others.

Carbon Pipes. National Carbon Co., Inc., Carbon Sales Division, Cleveland, Ohio.—Catalog Section M8800A—8-page folder giving information on this concern's "National" and "Karbate" carbon and graphite corrosion resistant pipes, tubes and fittings. Includes a discussion of properties, a table of the resistance to various chemicals at different temperatures, types of joints available, and dimensions of threaded carbon, graphite and "Karbate" fittings. Also includes data on heat exchangers. Illustrated by photographs and cross-sectional drawings.

Chemicals. Monsanto Chemical Co., St. Louis, Mo.—26th edition of this concern's catalog which contains 170 pages of information on the products put out by the company. Items are listed alphabetically. Each product contains condensed information on its characteristics, railroad classification, specifications, properties and typical analyses, and industrial uses. Contains chemical names, trade names and formulas. A general technical section includes tables of physical constants for some of the most common chemicals. Also lists other literature available from the company. Very well organized. Illustrated.

Chromium Plating. United Chromium, Inc., 51 E. 42nd St., New York, N. Y.—Bulletin 68—16-page bulletin summarizing applications where Industrial Chromium Plating saves materials and manhours in production and maintenance of metal products. Gives specific examples and offers suggestions on how existing plating equipment can be converted to "hard" chromium plating for war production.

Control Instruments. The Bristol Co., Waterbury, Conn.—Bulletin 43—Bulletin dealing with this concern's systems of automatic control for regulating gas saturation in natural gas distribution systems. Sketches are included to show methods of use. Also 12-page Bulletin 103, giving information concerning applications of automatic control instruments on synthetic rubber processes. Illustrated with typical installations and sketches showing applications of the instruments. Also Data Sheet 39, containing information on the application of telemetering to the measurement of gas distribution pressures. Gives information on a number of typical installations with sketches to show uses.

Conveyor Pulleys. The American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa. — Bulletin CP42 — 4-page folder dealing with this concern's new steel conveyor pulleys of both the solid and the split types. Each type is described briefly and illustrated. Contains a list price of the units.

Crushing and Grinding Equipment. American Manganese Steel Division, American Brake Shoe & Foundry Co., 389 E. 14th St., Chicago Heights, Ill.—Bulletin 642C—24-page bulletin on this concern's manganese steel for crusher, grinding mill and pulverizer parts. Contains numerous illustrations and brief descriptive material on parts such as those for jaw crushers, roll crushers, grinding mills, hammermills, etc. Contains general information on the properties, life and general features of this steel.

Dryers. Hardinge Co., York, Pa.—Bulletin 16C—36-page catalog dealing with this concern's line of Ruggles-Coles dryers. Discusses fundamentals of drying and classification of materials into groups. Gives description, operating data, efficiency, and sizes of the various classes of units. Includes a chart of performance data and numerous photographs as well as cross-sectional drawings.

Dryers. McNally Pittsburg Mfg. Corp., 307 N. Michigan Ave., Chicago, Ill.—Bulletin 242—8-page bulletin on this concern's McNally-Vissac dryer for thermal and mechanical drying of granular materials such as coal, etc. Discusses principles of thermal and mechanical drying, construction features and control of drying gases. Illustrated by photographs and working diagrams.

Electrical Apparatus Maintenance. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Department 7N—Pasteboard maintenance check chart, 16½x 12½ in., covering hints for maintenance of motors, control equipment, lightning arresters, wiring fuses and transformers.

Electrical Connectors. Burndy Engineering Co., Inc., 107 Eastern Blvd., New York City—48-page, pocket-size catalog containing drawings and photographic illustrations of 75 electrical connector types put out by this concern. Also contains condensed information on each type, partial listings of important connector sizes and wiring data.

Electrical Equipment. Ohmite Mfg. Co., 4835 Flournoy St., Chicago, Ill.—16-page catalog on the line of rheostats, resistors, tap switches, chokes and attenuators put out by this concern for radio, sound, electronic and industrial uses. Each of the units is described briefly and illustrated. Includes tables of specifications and price lists.

Electric Motor Maintenance. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—24-page booklet entitled "A Guide to War-Time Care of Electric Motors," which contains helpful hints on maintenance in clear, concise style, aided by numerous sketches. Tabulates methods of protecting electric motors from dust, stray oil, moisture, friction, misalignment, vibration, overload, etc. Also contains a handy chart for quick diagnosis of motor ailments.

Electrical Apparatus Maintenance. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. — Department 7N20 — Two-volume, 220-page maintenance notebook written by engineers and available to men concerned with the care of electrical apparatus in industry. Made up of 15 chapters for loose-leaf insertion in 5x7-in. binders. The first volume covers inspection of electrical apparatus, insulation materials and applications, cleaning, drying and testing of insulation, commutator maintenance, starting and regulating a.c., d.c. and squirrel-cage induction motors. Contains information for proper maintenance of insulation and motors, including diagrams, tables and charts. Vol. 2 is devoted to contactor maintenance, inspection of transformers and transformer connections. A number of wiring diagrams include all the more common connections.

Equipment. The C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland, Ohio—Bulletin 89—56-page catalog which illustrates and describes the line of rotary dryers, kilns, calciners, coolers, batch dryers and pressure autoclaves put cut by this concern. Describes principles and outstanding features of the various types of equipment, uses in industrial operations, and specifications. Contains a humidity chart and other tables of engineering data. Includes numerous photographic illustrations of the units.

Equipment. The United States Stoneware Co., 60 E. 42nd St., New York, N. Y.—Bulletin D—12-page bulletin summarizing the line of process equipment put out by this concern. Includes photographs and brief descriptive material on tanks and other equipment lined with "Tygon" resins, "Resilon," rubber, lead and alloys, and acid brick and cement. Also contains condensed information on tower packings and chemical stoneware equipment.

Fire Protection. Walter Kidde & Co., Inc., 122 E. 42nd St., New York, N. Y.—Vol. 1 No. 1 of this concern's new house organ entitled "High Pressure," which will be devoted to reviews of recent developments in fire protection and handling of compressed gases. Includes articles, numerous illustrations, and a department to review industrial safety news.

Flexible Couplings. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.—Bulletin 642—8-page bulletin describing and illustrating this concern's flexible coupling of all-metal construction, floor lubricated and flame-hardened wearing parts. Describes outstanding features of the unit, its construction, lubrication, installation, and capacity. Contains cross-sectional drawings, a price list and dimensional data.

Graphite. Nassau Laboratories, Hackensack, N. J.—8-page folder which gives condensed information on the natural colloidal graphite available from this concern. Gives information on properties, industrial uses, and outstanding features of the various grades of the product, trade-marked "Cograph." The product is suitable for suspension in the thinnest lubricant and liquid fuel to form a skin over bearing and shaft surfaces, preventing wear, overheating, rust and carbon formation.

Heating Coke Ovens. Koppers Co., Engineering and Construction Division, Pittsburgh, Pa.—14-page reprint entitled "New Principles in Heating Koppers-Becker Coke Ovens." Discusses fundamentals of combustion in oven flues, recirculation of waste gases, autogenic decarbonization, performance characteristics of regenerators, etc. Contains considerable engineering information in text form as well as in numerous drawings and charts. Includes references.

Instruments. The Taylor Instrument Cos., Rochester, N. Y.—Catalog 76JF—24-page catalog dealing with this concern's indicating, recording and controlling instruments for pressure. Each of the units is described briefly and illustrated by photographs. Contains selection charts and a complete price list. Data on charts for the various units are also included.

Laboratory Equipment. Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill. — Bulletin 515 — 8-page folder describing briefly and illustrating this concern's line of Kjeldahl equipment for digestions and distillation. Gives possible modifications and combinations for various purposes and a description of outstanding features.

Lubricants. Standard Oil Co., Sales Technical Service Dept., Chicago, Ill.—Form MQ52—38-page engineering bulletin for instruction of industrial salesmen entitled "Maintaining the Quality of Lubricants in Service." Includes a detailed discussion of types of contaminants and contamination, prevention of entrance of extraneous materials in lubricants, prevention of formation of deterioration products, purification equipment and methods, industrial applications of purification, and maintenance of grease quality. Contains very helpful ideas in text form and in numerous cross-sectional diagrammatic drawings.

Maintenance. Johns-Manville, 22 E. 40th St., New York, N. Y.—Form PP9A—10-page booklet entitled "101 Suggestions for Good Operating Practice" which outlines in tabular form hints on lengthening the life of packings, insulations, roofings, friction materials, and refractory products. Contains a summary of good installation and maintenance practices. Organized for quick reference.

Oil Conservation. Gale Oil Separator Co., Inc., Chrysler Building, New York, N. Y.—Two 4-page folders dealing with this concern's systems for oil reclaiming and conservation. Also describes the concern's method of cleaning cutting oils. Contains brief descriptive material.

Packaging. Acme Steel Co., 2840 Archer Ave., Chicago, Ill.—8-page reprint giving tables of sizes, weights and footages for both nailed and nailless types of steel strapping for shipments. Sketches show how shipments should be reinforced for safe arrival. Includes numerous illustrations showing various applications to a wide variety of items, including chemicals, textiles, etc.

Plant Protection. Clinton Carpet Co., Division of American Hair & Felt Co., Merchandise Mart, Chicago, Ill.—12-page bulletin dealing with blackout, air-raid damage and glass splinter protection for industrial plants. Discusses principles of plant protection and then deals with the line of "Ozite" air-raid safety and blackout blankets put out by the concern. Discusses the blankets and shows suggested installation methods on windows, skylights and similar openings. Extensively illustrated by drawings.

Power Recovery. L. H. Gilmer Co., Tacony, Philadelphia, Pa.—Form 365—26-page booklet dealing with the national power recovery plan developed by this concern. Outlines the plan and shows how power losses can be reduced. Includes power-recovery estimator forms which discuss various ways of saving and estimating power losses. Includes electricity, steam, mechanical power, water, compressed air, refrigeration, boiler room practice, prime movers and miscellaneous. The plan has the approval of the War Production Board.

Print Making. Ozalid Products Division, General Aniline & Film Corp., Johnson City, N. Y.—26-page bulletin entitled "Simplified Print Making" which describes the "Ozalid" process of making dry developed, positive-type whiteprints by use of this concern's machines and equipment. Includes a discussion of the process, sensitized materials and advantages of the machines for large-scale production of white prints. Written especially for engineers, draftsmen and architects.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Data Sheets, of from 2 to 8 pages each which give condensed information on selection, installation, operation and maintenance of all types of industrial pumps for general and specialized services. The more elementary sheets will be useful in training inexperienced employees, while the technical sheets should help operators obtain maximum performance from existing equipment. Also includes an 18-page pamphlet entitled "Pump Fundamentals." Contains much useful engineering data in condensed form. Extensively illustrated by drawings and charts.

Pumps. The Watson-Stillman Co., Roselle, N. J.—Bulletin 260A—6-page bulletin dealing with this concern's line of high pressure motor-driven vertical pumps, including simplex, duplex and triplex types in various models and capacities. Each unit is briefly discussed and illustrated. Contains tables of engineering data.

Recording Thermometers. The Bristol Co., Waterbury, Conn.—Bulletin T302—six-page folder giving detailed information concerning construction of this concern's fully-compensated liquid-filled recording thermometers for temperatures between —125 deg. F. and +400 deg. F. Also contains information on applications and various forms in which they are furnished. Illustrated by drawings.

Rubber Conservation. The B. F. Goodrich Co., Akron, Ohio—Section 2158—4-page form on belt vulcanizers for splicing and repair. Gives details on type of construction, dimensions, capacity and splicing tools. Illustrated.

Rubber Linings. The B. F. Goodrich Co., Akron, Ohio—Catalong 9000—4-page section on this concern's "Vulcalock" rubber linings for handling corrosives and abrasives. Gives service recommendations, general information, standard type of linings and tables of chemical resistance to solutions of inorganic acids, salts and alkalis, and organic materials.

Salvaging Tools. Eutectic Welding Alloys, Inc., 40 Worth St., New York, N. Y.—4-page folder on this concern's new process to speed salvaging of tools and parts with "Castolin" eutectic low-temperature welding. Contains illustra-

tions and brief descriptive material and also a table showing which Castolin alloys are recommended for tools, salvage and maintenance.

Silver Alloy Brazing. Handy & Harman, 82 Fulton St., New York, N. Y.—6-page booklet entitled "Silver Alloy Brazing of Fabricated Copper Piping." Describes in detail procedure for inside feed method, outside feed, annealing silver alloy brazed copper piping, branch outlets and pipe reduction, etc. Well illustrated by numerous sketches.

Stainless Steel Fabrication. Republic Steel Corporation, Republic Building, Cleveland Ohio—40-page booklet giving information on fabrication of this concern's Enduro stainless steel. Contains detailed information on proper procedure for shearing, blanking, drawing, machining, riveting, etc. Describes each of the operations and illustrates proper procedure with photographs. Contains extensive tables of engineering data on properties of stainless and heat-resisting steels, hardness conversion table, and comparative physical and mechanical properties of ferrous and non-ferrous metals.

Steam Jet Ejectors. Worthington Pump and Machinery Corp., Harrison, N. J.—Bulletin W205B7A—6-page folder which illustrates and describes the outstanding features of this concern's steam-jet ejectors of the 2-stage condensing type. Includes information on materials of construction, cross-sectional drawings, and various engineering data.

Switchboard Instruments. Roller-Smith Co., Bethlehem, Pa.—Catalog 4220—12-page catalog on the line of switchboard instruments put out by this concern. These include various ammeters, voltmeters, power factor meters, etc. Includes information on dimensions, weight and list prices of all instruments. Illustrated by dimensional drawings and photographs of the units.

Tempering. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Catalog T625—29-page publication entitled "Homo Method for Tempering." Discusses and illustrates how the method helps to overcome heat-treating bottlenecks in industry. Includes a discussion of outstanding features, method of operation, construction, applications, and furnace equipment. Extensively illustrated.

Warfare Chemical Hazards. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.—19-page reprint giving a rational viewpoint of the hazards of chemical warfare gases Presents a general discussion of chemical warfare, common effects of warfare agents, and properties, physiological action and first aid treatment for the principal war gases.

Water Treatment. The American Water Softener Co., Lehigh Ave. and 4th St., Philadelphia, Pa.—Bulletin 101B—12-page bulletin entitled "Corrective Chemical Feeding" which discusses briefly this concern's line of equipment for chemical feeding in water treatment. Extensively illustrated by photographs, cross sectional drawings, and charts.

War Specifications. Jones-Dabney Co., Industrial Division of Devoe & Raynolds Co., Inc., Louisville, Ky.—16-page booklet which gives specifications and codes of the Army, Maritime Commission and other government agencies for lacquers, varnishes, enamels and certain synthetic resins. Includes information on the uses of each of the specified products.

Welding. The Lincoln Electric Co., Cleveland, Ohio—Bulletin 432—18-page folder describing this concern's "Fleet-Fillet" welding technique for speeding war production wherever arc welding is used. Includes detailed information on principles and background of the technique, practical aspects, comparison tests, use of electrodes, operating procedures, etc. Includes photographs and cross-sectional drawings, as well as tables of engineering data on capacities, specifications and electrode consumption.

Welding. Tube-Turns, Inc., 224 E. Broadway, Louisville, Ky.—First issue of this concern's new house organ entitled "Sparks", which will be devoted to welding operations in increasing production of war materials. Extensively illustrated.

CHEM & MET ECONOMICS & MARKETS

INDUSTRIAL CONSUMPTION OF CHEMICALS DROPS CLOSE TO LEVELS OF A YEAR AGO

With fairly complete figures available for the first half of this year, it is possible to compare the progress of chemical manufacture with that for the corresponding period of last year. From a production standpoint, the unadjusted index of the Federal Reserve Board shows an average of 131 for the Jan.-June period in 1941 and 163 for 1942 or an increase of 25 percent for the first half of the current year. The *Chem. & Met.* index for consumption of chemicals for the same periods averages 159.26 and 170.77 respectively or an increase of little more than 7 percent for the 1942 months. The adjusted index for industrial production as now reported by the Federal Reserve Board is 175 for May and 178 for June. Earlier the June index had been estimated at 180 and it was stated

	Chem. & Met. Index 1942	Chem. & Met. Index 1941	Federal Res. Index 1942	Federal Res. Index 1941
Jan.	177.12	155.01	155	122
Feb.	162.84	146.81	161	124
March	176.38	158.28	165	129
April	171.38	161.96	167	136
May	171.12	170.45	166	135
June	166.56	163.08	165	138

that the index for June 1941 was 159 made up of 32 points of war production and 127 points of civilian goods production. The June 1942 index was reported as composed of 88 points of war production and 92 points of civilian goods output. On this basis war production in the year ended June rose 175 percent while civilian production declined 28 percent. These figures give a clear picture of the influences which war-time conditions are exerting on general industry and go a long way in explaining the discrepancy between indexes for total chemical production and those for industrial consumption of the same products.

Referring to the industries which are most important as consumers of chemicals, it is found that very little change in conditions has come to light in the last month. Paper mills have continued to cut down activities with new orders falling below the current production rates. Petroleum refiners are less active than they were a year ago. Glass plants hold a fairly even rate which means that outputs of containers and window glass are high and plate glass production very low. Operations at steel mills vary within narrow limits and textile plants show large outputs but in the woolen branch, carpet production has almost reached a vanishing point and considerable change is noted in the type of material now being turned out by cotton mills. Rayon output continues on a high plane with increased outputs of staple adding to the record performance.

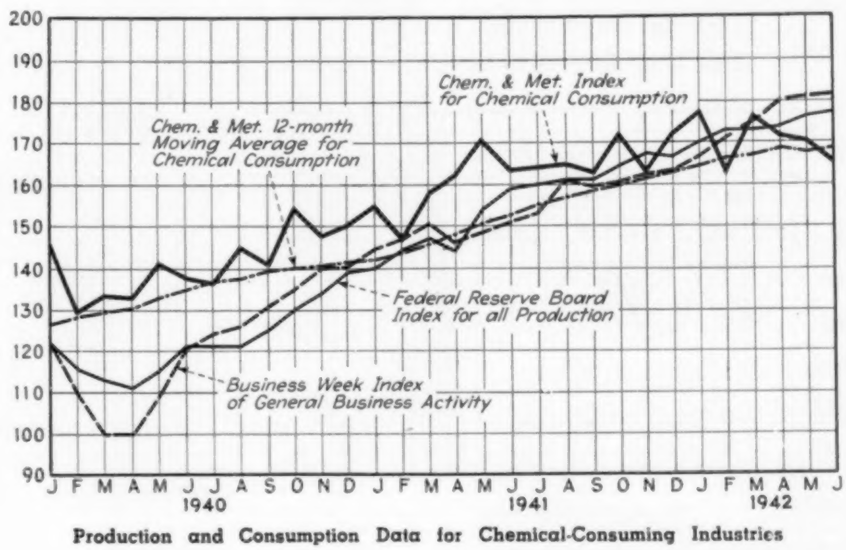
The index for consumption of chemicals for June is preliminarily placed at 166.56 which represents a rather sharp drop from the revised figure of 171.12 for May. The upward revision for May was caused by a larger output of superphosphate than had been estimated.

While a large part of the outputs of the industries which are components of the index for chemical consumption are of military importance and must be maintained in volume, the increasing war needs are forcing a steady conversion of plants to the war effort and this is bound to have a wide-spread effect on the distribution of raw materials as time goes on. Up to the present, limitations of output of civilian industries have been attained largely by imposing uniform percentage cuts on all firms. It is now announced that the war program makes it necesary to concentrate production of civilian goods where some or all of these plants can be converted for war production; where already production is so restricted that economic operation of all plants is not possible; and where production is located in areas where there are bottlenecks in labor, transport, power or warehouse facilities.

Chem. & Met. Index for Industrial Consumption of Chemicals

1935 — 100

	May	June
Fertilizers	34.60	35.04
Pulp and paper	21.06	19.40
Petroleum refining	13.97	13.65
Glass	16.88	16.06
Paint and varnish	15.97	14.27
Iron and steel	13.73	13.27
Rayon	14.97	14.89
Textiles	11.95	12.26
Coal products	9.98	9.52
Leather	4.90	4.80
Industrial explosives	5.91	6.15
Rubber	3.00	3.00
Plastics	4.20	4.25
	171.12	166.56

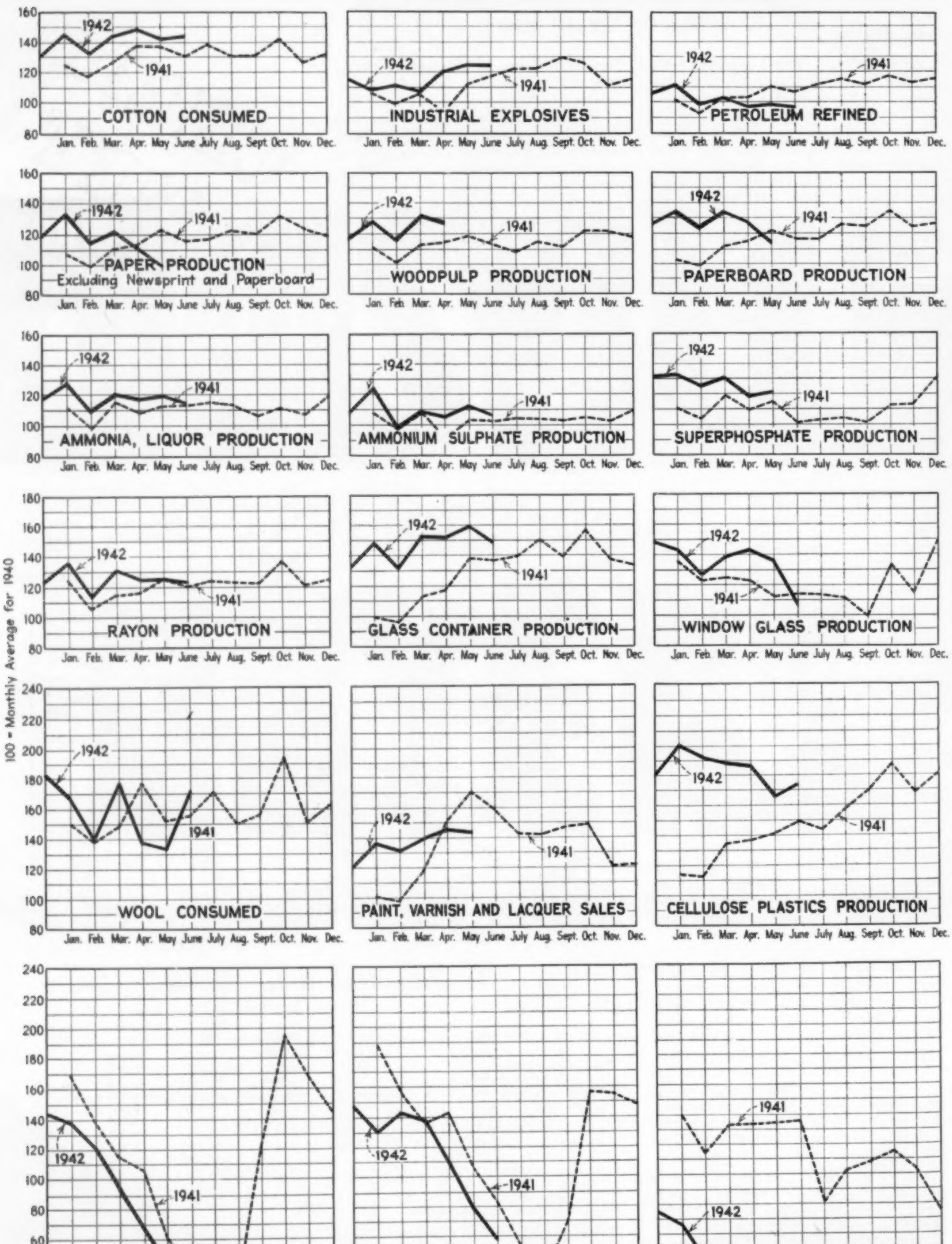


Production and Consumption Data for Chemical-Consuming Industries

Production	June 1942	June 1941	January-June 1942	January-June 1941	Percent of gain for 1942
Ammonia, liquor, 1,000 lbs.	5,440	5,356	33,503	31,144	7.6
Ammonium sulphate, tons	63,888	61,376	383,890	368,264	4.2
Byproduct coke, 1,000 tons	5,118	4,842	30,617	28,624	7.0
Coal-tar, 1,000 gal.	60,788	57,347	368,620	344,549	7.0
Creosote oil, 1,000 gal.	3,771	2,723	20,134	17,377	15.9
Glass containers, 1,000 gr.	6,723	6,168	40,491	31,746	27.5
Plate glass, 1,000 sq. ft.	4,726	18,534	34,914	108,553	67.8*
Window glass, 1,000 boxes	1,223	1,304	9,103	8,361	8.8
Cottonseed oil, crude, 1,000 lb.	......	......	524,328	560,764	6.5*
Soybean oil, 1,000 lb.	......	......	356,750	292,781	21.8
Linseed oil, 1,000 lb.	......	......	499,735	379,564	31.7
Castor oil, 1,000 lb.	......	......	99,324	66,105	50.2
Cellulose acetate plastics, 1,000 lb.					
Sheets, rods and tubes	557	513	3,261	2,864	13.8
Molding compounds	3,241	2,457	20,937	12,773	63.8
Nitrocellulose plastics, 1,000 lb.	1,374	1,387	8,514	7,785	9.4
Consumption					
Cotton, bales	966,940	875,812	5,728,994	5,213,314	9.9
Industrial explosives, 1,000 lb.	42,101	39,460	234,545	214,770	9.2
Cottonseed oil, bbl.	194,105	318,152	1,367,409	2,078,948	34.2*

* Percent of decline.

Production and Consumption Trends



SOME CHEMICALS ARE IN MORE PLENTIFUL SUPPLY AND GOVERNMENT CONTROLS ARE EASED

Some of the government regulations issued in recent weeks have reversed the usual procedure by easing controls previously imposed on distribution of chemicals. Not long ago, concern was expressed regarding the probable supply of alcohol particularly for the anti-freeze trade. In the latter part of July an amendment was made to Order L-51 providing that deliveries of anti-freeze made from alcohol may be made without restriction if total acceptances are not in excess of the quantity required for use and resale in the season from April 1, 1942 to March 31, 1943.

On the first of August, announcement was made that large industrial users of chlorate chemicals might acquire stockpiles. The new provision of Order M-171 states that present inventories may be frozen and month by month consumption met by allocation. The order further increases unrestricted deliveries to any one person from ten pounds to twenty-five pounds. Chlorine was one of the first chemicals to be placed under complete control but production has grown rapidly and it is now stated that supply is about in line with demand. Restrictions on the use of chlorine in 100 percent rag-content paper have been removed. Previously the brightness ceiling had been placed at 82 percent but has now been revised to 100 percent. This is not entirely due to freer supplies of chlorine as it is stated that investigation proved that only small amounts of chlorine were required for the 100 percent brightness ceilings.

The sharp rise in output of chlorine has resulted in a larger production of caustic soda on the part of electrolytic plants. While consumption of caustic has been large it has fallen short of production and disposal of this surplus appears to be more than a temporary problem. Stocks of carbon tetrachloride likewise have increased and to ease this condition permission is granted to users with a B-2 rating to double the amount they may consume up to Sept. 30. Those with B-2 rating include users for degreasing machines other than those for Army and Navy contracts, producers of packaged cleaning products, drycleaners, and cleaners of metal parts of electrical equipment.

Generally, however, government orders continue to tell a story of shortages in chemicals with war-time needs curtailing amounts available for less essential purposes. At the close of last month, production and distribution of pyridine were put under complete allocation. In explanation it was stated that this material is vitally important for sulpha drugs, for the manufacture of the water repellant Zelan, and for the manufacture of nicotinic acid. The order provides that from Sept. 1, no deliveries may be made except as authorized. It also forbids anyone to use or deliver crude pyridine bases except for extraction of pyridine, exemption made only in the case of users of less than 10 gallons a month. Earlier in the month xylol and xylol range aromatic materials derived from coal-tar were brought under control. This order merely extended the range of one already in existence which covered such products of petroleum origin.

Other materials to come under control included phthalate plasticizers. The allocation system becomes effective Sept. 1. Deliveries of five gallons or less of each type to one user in a month are not restricted nor are deliveries of 55 gallons of any one type or 110 gallons of different kinds to a single user. Up to Aug. 1, only 80 percent of cotton linter production was controlled but now delivery of all cotton linters and hull fiber is forbidden except to designated makers of chemical cotton pulp. Under the amended order all producers of cotton linters must accept all orders from pulp manufacturers and must fill them in order of their receipt without regard for preference ratings. Importers of linters are covered the same as producers. Producers also may be requested to turn out the maximum amount of the type of linters and fiber most urgently needed in chemical cotton pulp manufacture.

With the disruption of trade with the Far East, imports of shellac have dropped and on July 31, this material came under complete allocation and specific authorization must be obtained before making deliveries. It is intimated that civilian use of shellac will be practically eliminated. Producers of records had previously been limited to 30 percent of their former requirements and it remains to be seen how, under the new order, requests for supplies will be answered.

Price developments under government action included the restoration of maximum prices for chrome yellow, chrome green, molybdate orange and zinc yellow color pigments to the April 1, 1942 level. Because demand exceeded supply, values for natural and syn-

CHEM. & MET. Weight Index of CHEMICAL PRICES

Base=100 for 1937

This month	**109.11**
Last month	109.33
August, 1941	102.91
August, 1940	98.63

Prices for naval stores have shown almost daily fluctuations with the net change being in favor of lower levels. Sales levels for natural and synthetic pine oil have been rolled back to that prevailing in October last year. Resale lots of caustic soda were available at reduced figures.

thetic pine oil had moved up where they constituted a price squeeze and they were ordered to be put at the figures obtained in October 1941. The Navajo Fluorspar Mines has been given authority to sell fluorspar crude ore having a 70 percent CaF_2 content on a dry basis at a maximum price of $10 a ton fob Grants, New Mexico. Petition of Harry M. Williamson & Son has been approved. This calls for sales of acid grade fluorspar having analysis of 98 percent CaF_2 and 1 percent SiO_2 at $28 a ton fob Boulder, Colo.

OPA has announced a reduction in the price for imported cresylic acid. Domestic stocks have not been large enough to take care of requirements and buyers have turned more and more to the imported material. While the price of domestic acid had been stabilized at levels averaging less than 70c. a gal. in tank cars, the cost of imported has advanced from a prewar figure of 50c. to $1.80 a gal. The current price control for imported applies to sales and deliveries of 60 gal. or more and the price which importers may ask is based on an ex-British works cost of 70c. a gal. for 99-100 percent pale cresylic acid. In addition importers may mark up 10c. a gal. to cover profit and costs not specifically provided for. On this formula the sales price will work out around $1.10 a gal.

Maximum prices for chemical grade cotton linters has been fixed at 4.35c. a lb. for linters of all grades with a 73 percent cellulose content. To encourage maintenance of a high cellulose content a differential of nine ten-thousands of a cent is allowed for every one percent variation from the basic 73 percent content.

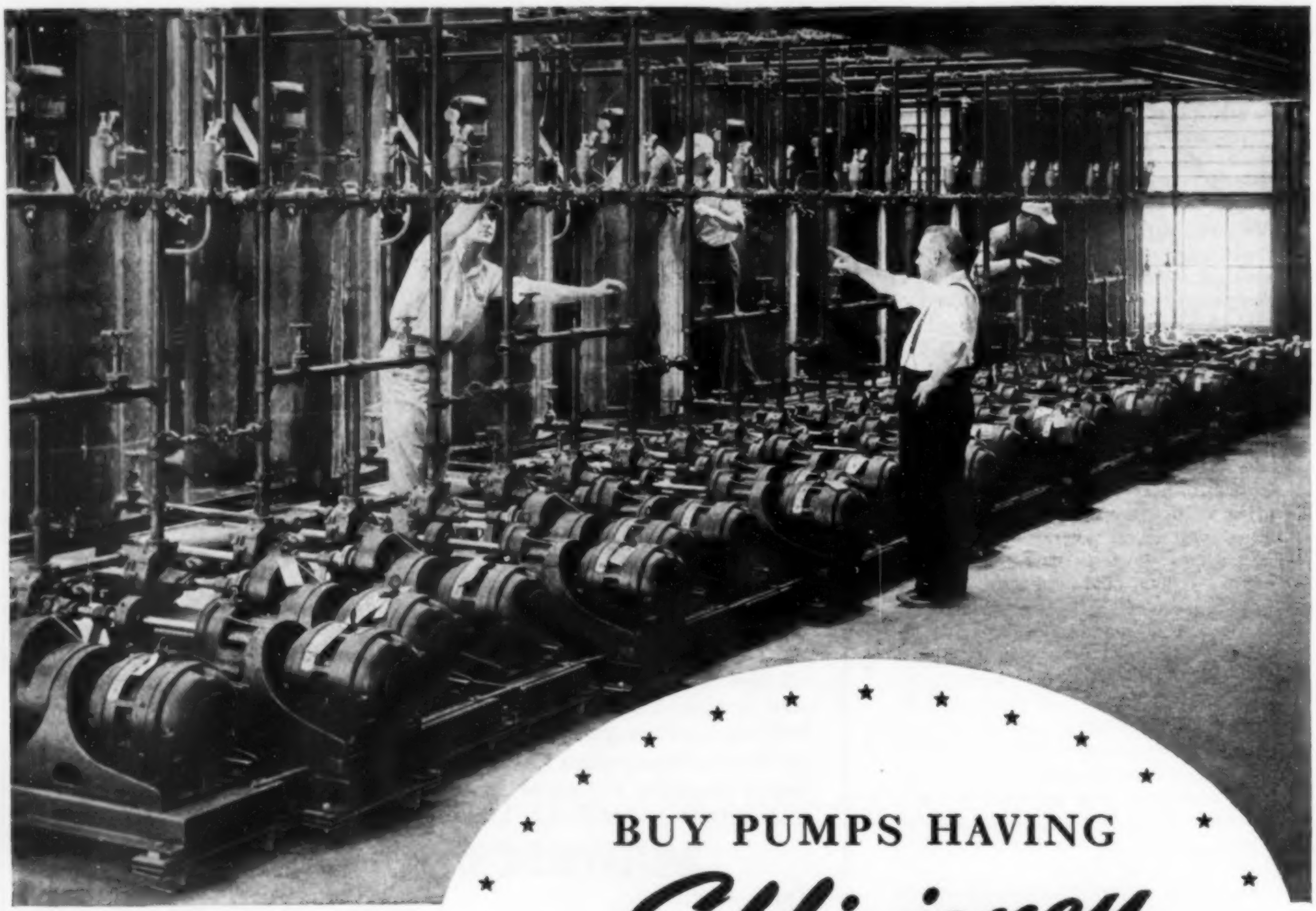
Ethyl alcohol used in the manufacture of synthetic rubber is exempt from the provisions of the General Maximum Price Regulation. For the purpose of price flexibility during the formative period of the synthetic rubber industry numerous chemicals were previously exempted from the price controls and this action adds ethyl alcohol to the list. Outside the rubber industry, price controls over alcohol remain as before.

CHEM. & MET. Weighted Index of Prices for OILS & FATS

Base=100 for 1937

This month	**141.53**
Last month	143.22
August, 1941	122.80
August, 1940	68.24

Lower ceilings went into effect for some of the animal fats and this resulted in large sales of tallow. Linseed oil, under bearish crop news and light consuming demand, was lowered in price. Crude cottonseed oil sold off in Texas and soybean oil has been easier. Other oils showed but little price change.



These 36 F-M motor-driven rotary pumps in a large manufacturer's paint mixing room serve distant paint spray booths.

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FAIRBANKS-MORSE

PUMPS
DIESELS
MOTORS
SCALES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.168–$0.173	$0.168–$0.173	$0.08½–$0.09
Acid, acetic, 28%, bbl., cwt	3.38 – 3.63	3.38 – 3.63	3.18 – 3.43
Glacial 99.5%, drums	9.15 – 9.40	9.15 – 9.40	8.43 – 8.68
U. S. P. X 1, 99.5%, dr	10.95 –11.20	10.95 –11.20	10.25 –10.50
Boric, bbl., ton	108.00–113.00	108.00–113.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.10 – 1.15	1.10 – 1.15	1.05 – 1.15
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb	.073– .075	.073– .075	.06½– .06¾
Muriatic 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.11¼– .13	.11¼– .13	.10¾– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.71 – .73	.71 – .73	.64 – .66
Tartaric, powd., bbl., lb	.70 –......	.70 –......	.63 –......
Tungstic, bbl., lb	nom	nom	nom ......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.131–......	.131–......	.121–......
Alcohol, Butyl, tanks, lb	.158–......	.158–......	.10 –......
Alcohol, Ethyl, 190 p'f., bbl., gal	8.19 – 8.25	8.19 – 8.25	6.04 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks	.60 –......	.60 –......	.33 –......
Alum, ammonia, lump, bbl., lb	.03¾– .04	.03¾– .04	.03½– .04
Potash, lump, bbl., lb	.04 – .04¼	.04 – .04¼	.04 – .04¼
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.85 – 2.10	1.85 – 2.10
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09¼– .12	.09¼– .12	.09 – .12
Sulphate, wks., cwt	1.45 –......	1.45 –......	1.45 –......
Amylacetate tech., from pentane, tanks, lb	.145–......	.145–......	.115–......
Antimony Oxide, bbl., lb	.15 –......	.15 –......	.12 –......
Arsenic, white, powd., bbl., lb	.04 – .04¼	.04 – .04¼	.04 – .04¼
Red, powd., kegs, lb	nom	nom	nom ......
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	55.00 –60.00
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.11 – .12	.11 – .12	.09½– .10
Blanc fix, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.25 – 2.35	2.25 – 2.35	2.00 – 2.10
Borax, gran., bags, ton	44.00 –......	44.00 –......	43.00 –......
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	3.00 –......	3.00 –......
Arsenate, dr., lb	.07 – .08	.07 – .08	.07½– .07¾
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	18.00 –24.00	18.00 –24.00	19.00 –24.50
flake, bags., del., ton	18.50 –25.00	18.50 –25.00	20.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05½–......	.05½–......	.05 –......
Tetrachloride drums, gal	.73 – .80	.73 – .80	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb	2.00 –......	2.00 –......	1.75 –......
Cylinders	.05¼– .06	.05¼– .06	.05¼– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.18 – .20	.18 – .20	.18 – .20
Sulphate, bbl., cwt	5.15 – 5.40	5.15 – 5.40	5.00 – 5.25
Cream of tartar, bbl., lb	.57 –......	.57 –......	.52 –......
Diethylene glycol, dr., lb	.14 – .15½	.14 – .15½	.22 – .23
Epsom salt, dom., tech., bbl., cwt	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Ethyl acetate, drums, lb	.12 –......	.12 –......	.08½–......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06¼	.05½– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.18 – .19	.18 – .19	.17½– .19
Glaubers salt, bags, cwt	1.05 – 1.10	1.05 – 1.10	1.05 – 1.10
Glycerine, c.p., drums, extra, lb	.18¾–......	.18¾–......	.14¼–......
Lead:			
White, basic carbonate, dry casks, lb	.08¼–......	.08¼–......	.07¼–......
White, basic sulphate, sck., lb	.07¼–......	.07¼–......	.07¼–......
Red, dry, sck., lb	.09½– .09½	.09½–......	.0835–......
Lead acetate, white crys., bbl., lb	.12¾– .13	.12¾– .13	.12 – .13
Lead arsenate, powd., bag, lb	.11 – .12	.11 – .12	.09½– .11
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, powd., csk., lb	.08½–......	.08½–......	.0735–......
Lithopone, bags, lb	.04¼– .04½	.04¼– .04½	.038– .04
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to August 13

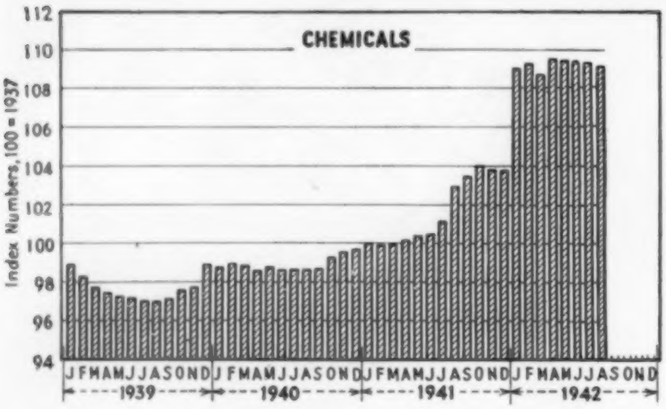
CHEM & MET CURRENT PRICES

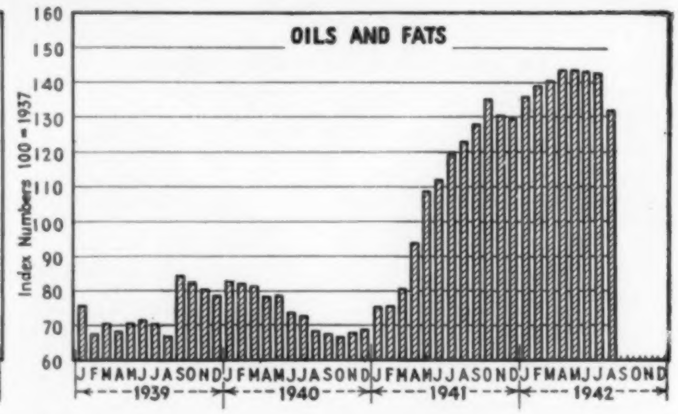
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.60 –......	.60 –......	.73 –......
97%, tanks, gal	.60 –......	.60 –......	.75 –......
Synthetic, tanks, gal	.28 –......	.28 –......	.30 –......
Nickel salt, double, bbl., lb	.13½– .13½	.13½– .13½	.13½–......
Orange mineral, csk., lb	.12½–......	.12½–......	.11½–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.09½– .10	.09½– .10
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.19½– .20
Prussiate, yellow, casks, lb	.17 – .18	.17 – .18	.17 – .18
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	17.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb	.05 – .06	.04½– .06	.04½– .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07¾– .08	.07¾– .08	.07¾– .08
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	16.00 –17.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.08 – .09	.08 – .09
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.50 – 2.65	2.50 – 2.65	2.35 – 2.40
Nitrate, bulk, cwt	1.35 –......	1.35 –......	1.47 –......
Nitrite, casks, lb	.06¾– .07	.06¾– .07	.06¾– .07
Phosphate, tribasic, bags, lb	2.70 –......	2.70 –......	2.35 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb	.03 – .03½	.03 – .03½	.03 – .03½
Sulphite, crys., bbl., lb	.02¼– .02½	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.90 – 2.40	1.90 – 2.40	1.60 – 3.00
Tin Oxide, bbl., lb	.55 –......	.55 –......	.55 –......
Crystals, bbl., lb	.39½–......	.39½–......	.39½–......
Zinc, chloride, gran., bbl., lb	.05½– .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.10¼–......	.09¼–......	.09¼–......
Zinc oxide, lead free, bag, lb	.07¼–......	.07¼–......	.06¼–......
5% leaded, bags, lb	.07¼–......	.07¼–......	.06¼–......
Sulphate, bbl., cwt	3.85 – 4.00	3.85 – 4.00	3.15 – 3.25

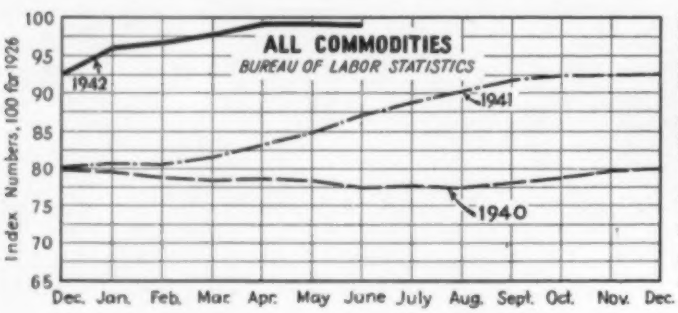
OILS AND FATS

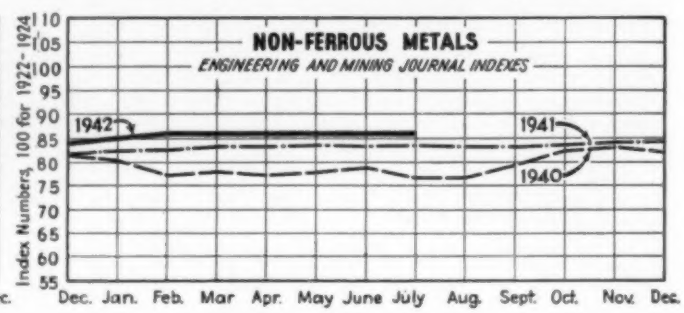
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.13¾–$0.14¼	$0.13¾–$0.14¼	$0.11¼–$0.12
Chinawood oil, bbl., lb	.38 –......	.38 –......	.33 –......
Coconut oil, Ceylon, tank, N. Y., lb	nom	nom	.07¾–......
Corn oil crude, tanks (f.o.b. mill), lb	.12¾–......	.12¾–......	.12 –......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12¾–......	.12¾–......	.10¾–......
Linseed oil, raw car lots, bbl., lb	.139–......	.139–......	.113–......
Palm, casks, lb	.09 –......	.09 –......	.07 –......
Peanut oil, crude, tanks (mill), lb	.12¾–......	.12¾–......	.12 –......
Rapeseed oil, refined, bbl., lb	nom	nom	.15½–......
Soya bean, tank, lb	.11½–......	.11½–......	.09¾–......
Sulphur (olive foots), bbl., lb	.19½–......	.19½–......	.16 –......
Cod, Newfoundland, bbl., gal	nom	nom	nom ......
Menhaden, light pressed, bbl., lb	.114–......	.114–......	.104–......
Crude, tanks (f.o.b. factory) gal	.66 –......	.66 –......	.60 –......
Grease, yellow, loose, lb	.08¾–......	.09295–......	.07¼–......
Oleo stearine, lb	.09½–......	.09½–......	.09½–......
Oleo oil, No. 1	.11½–......	.11½–......	.10½–......
Red oil, distilled, dp.p. bbl., lb	.11¼–......	.12 –......	.10½–......
Tallow extra, loose, lb	.08¾–......	.097125–......	.08 –......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	\$0.52– \$0.55	\$0.52 –\$0.55	\$0.52 –\$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb.	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb.	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal.	.15 –......	.15 –......	.14 –......
Beta-naphthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.11 –......	.11 – .11	.10½– .10¾
Cresylic acid, dr., wks., gal.	.81 – .83	.81 – .83	.76 – .78
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb.	.18 – .19	.18 – .19	.18 – .19
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. f.o.b. wks., lb.	.60 –......	.60 –......	....
H-acid, bbl., lb.	.45 – .50	.45 – .55	.45 – .50
Naphthalene, flake, bbl., lb.	.07 – .07¼	.07 – .07¼	.07 – .07¼
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb.	.13 –......	.13 –......	.12 –......
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal.	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs., lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal.	.27 –......	.27 –......	.27 –......
Tolidine, bbl., lb.	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.	.33 –......	.33 –......	.30 –......
Xylol, com., tanks, gal.	.26 –......	.26 –......	.26 –......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	\$22.00–\$25.00	\$22.00–\$25.00	\$22.00–\$25.00
Casein, tech, bbl., lb.	.15 – .17	.15 – .17	.21½– .22
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335– .30	.0335– .30	.0335– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.11 – .26	.11 – .26	.11 – .26
Chrome green, bbl., lb.	.21½– .30	.21½– .30	.21½– .30
Carmine, red, tins, lb.	4.60 – 4.75	4.60 – 4.75	4.60 – 4.75
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	3.05 – 3.10	3.05 – 3.10	3.20 – 3.25
Chrome yellow, C.P., bbl., lb.	.14½– .15¼	.14½– .15¼	.14½– .15¼
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 – .10	.08 – .10	.08 – .10
Gum copal Congo, bags, lb.	.09 – .30	.09 – .30	.08 – .30
Manila, bags, lb.	.09 – .15	.09 – .14	.09 – .14
Demar, Batavia, cases, lb.	.10 – .22	.10 – .20	.10 – .22
Kauri, cases, lb.	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. mines), ton.	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton.	64.00 –......	65.00 –......	65.00 –......
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	nom	nom	.03 – .04
Rosin, H., 100 lb.	3.41 –......	3.73 –......	3.08 –......
Turpentine, gal.	.61 –......	.65½–......	.74 –......
Shellac, orange, fine, bags, lb.	.39 –......	.39 –......	.38 –......
Bleached, bonedry, bags, lb.	.39 –......	.39 –......	.35 –......
T. N. Bags, lb.	.31 –......	.31 –......	.28 –......
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 – 8.00	6.00 – 8.00	7.50 –11.00

Industrial Notes

COLGATE-PALMOLIVE-PEET CO., Jersey City, has transferred Emerson E. Wilson from the position of sales supervisor in the New York district to Pittsburgh where he will act as district manager.

HOSDREG CHEMICALS, INC., Huntington, Ind., has appointed J. I. Richards plant manager.

INTERNATIONAL NICKEL CO., New York, announces that Elmer W. Silver has been elected treasurer of its subsidiary, the Whitehead Metal Products Co. Mr. Silver will continue as secretary of The Whitehead company to which office he was elected last March.

RALPH C. COXHEAD VARI-TYPER CORP., New York, has appointed Harry Lee Coe and C. H. Heppenstall as special representatives in Washington, D. C. and Dayton, Ohio, respectively.

HERCULES POWDER CO., Wilmington, has moved its Detroit office to the Fisher Bldg. Philip F. Robb was recently transferred from Wilmington to manage the Detroit office.

U. S. INDUSTRIALS CHEMICALS, INC., New York, has moved its sales offices in Chicago to 630 South Michigan Ave.

YORK ICE MACHINERY CORP., York, Pa., has made James C. Tweedell general sales manager for the duration to succeed John R. Hertzler who has joined the Army-Navy Munitions Board.

ACME STEEL CO., Chicago, has transferred K. J. Pedersen to take charge of sales in North and South Carolina. The death of F. G. German and the induction of G. R. Easley made this change necessary. Mr. Pedersen will be located at 2243 Selwyn Ave., Charlotte, N. C.

J. F. PRITCHARD & CO., Kansas City, Mo., have moved their offices to the Fidelity Bldg.

AMERICAN METALS CO., New York, has elected as vice-presidents, Walter Hochschil who has been secretary and Norman Hickman manager of sales.

PROCTER & GAMBLE CO., Cincinnati, has elected Renton K. Brodie vice-president to succeed the late Herbert G. French.

SEAMLEX CO., INC., Long Island City, N. Y., has moved its plant and offices to 27 27 Jackson Ave.

How Industry Will Save $50,000,000 Worth of Solvents Annually

THOUSANDS of pounds of vaporized solvents are lost daily because adequate solvent recovery systems are not used. A solvent recovery system using "Columbia" Activated Carbon can not only prevent this solvent waste, but can speed manufacturing operations and decrease fire and health hazards.

Plants recovering solvents with "Columbia" Activated Carbon . . . those now built and those to be completed shortly . . . have the capacity to recover more than $50,000,000 worth of solvents annually.

Solvent vapor in concentrations as low as 0.25 pounds per thousand cubic feet of air is being recovered, often with efficiencies of 99 per cent or better*. Recovery expense is often less than 0.2 cents a pound and almost never exceeds one cent a pound. Operations can be entirely automatic. Solvent vapor concentrations are automatically kept far below the explosive range—an important safety feature. Solvent recovery plants built sixteen years ago are still operating efficiently and economically.

The solvent recovery system employing "Columbia" Activated Carbon benefits from the research done in America's leading laboratory devoted exclusively to carbon products, and from the experience accumulated by Carbide and Carbon Chemicals Corporation in the manufacture and use of industrial solvents.

*Less than one per cent of the collected solvent vapor is lost. Over-all recoveries of all solvent used vary with the vaporizing operation and the type of vapor-collecting system, but have exceeded 95 per cent.

Seven Advantages of The Solvent Recovery System Using "Columbia" Activated Carbon

1. Recovers all types of volatile solvents
2. Recovers solvent vapors in almost any concentration
3. Recovers solvents efficiently in presence of water vapor
4. Recovers solvent vapors with high overall efficiency
5. Recovery plant may be completely automatic in operation
6. Recovery plant investment moderate
7. Recovery expense low

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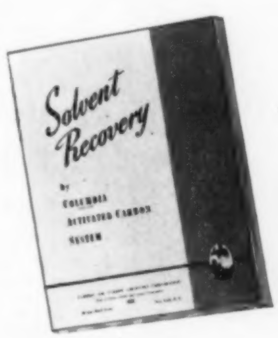

This 32-page book tells more about the solvent recovery system using "Columbia" activated carbon and its profitable applications. When you write for a copy, tell us the names and quantities of solvents you vaporize and how you collect the vapors, so that we can help you determine what you can save. No obligation, of course.

The word "Columbia" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

Representative Industries For Which We Have Designed and Supplied Complete Solvent Recovery Plants Include: *Rayon, Artificial Leather, Lacquer Coatings, Rubber, Rotogravure Printing, Smokeless Powder, Plastics, and Transparent Wrappings.*

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NEW CONSTRUCTION

	Current Projects		Cumulative 1942	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$40,000	$40,000	$2,630,000	$4,180,000
Middle Atlantic	115,000	7,170,000	6,961,000	711,141,000
South	2,000,000	6,040,000	11,345,000	71,073,000
Middle West	9,000,000	....	91,515,000	159,825,000
West of Mississippi	12,500,000	3,000,000	184,467,000	325,330,000
Far West	40,000	14,040,000	20,640,000	136,682,000
Canada	1,083,000	100,000	11,743,000	1,418,000
	$24,778,000	$30,390,000	$329,301,000	$1,409,649,000

PROPOSED WORK

Calif., Oakland—Par Soap Co. of Oakland, 767 85th Ave., is having plans prepared by Wurster & Wanger, Inc., 5201 South Kenwood St., Chicago, Ill., for reconstructing its two story plant. Estimated cost $40,000.

Indiana—Seagram & Sons, Inc., c/o H. F. Wilkie, Lawrenceburg, plans to construct a brick and concrete plant in Dearborn Co. Estimated cost will exceed $5,000,000.

Kansas—National Refining Co., Coffeyville, contemplates the construction of a refinery. Estimated cost $5,500,000.

Louisiana—Texas Co., 919 St. Charles St., New Orleans, Humble Oil & Refining Co., Humble Bldg., Houston, Tex., Tidewater Associated Oil Co. and Phillips Petroleum Co., both Esperson Bldg., Houston, Tex., plan to construct a plant. Estimated cost $2,000,000.

Md., Relay—Calvert Distilling Co., Relay, plans to construct a 1 story, 100x170 ft. regauging building. Estimated cost $75,000.

Mass., Hingham—U. S. Government, Wash., D. C., plans to construct a plant here to be leased to Air Reduction Sales Co., 60 East 42nd St., New York, N. Y. Estimated cost $600,000.

Ohio—Kelley Island Lime & Transportation Co., Leader Bldg., Cleveland, O., plans to construct kilns. Estimated cost $1,000,000.

Ohio—National Carbon Co., Inc., 30 East 42nd St., New York, N. Y., plans to construct a plant here. Estimated cost between $2,500,000 and $3,000,000.

Pennsylvania—Continental Refining Co., A. B. Weingard, Pres., Rouseville Rd., Oil City, plans alterations and additions to its plant. Estimated cost $40,000.

Texas—U. S. Government plans to construct a chemical plant. Estimated cost $3,000,000.

Wyo., Cheyenne — Frontier Refining Co., Cheyenne, plans to construct an addition to its refinery. Estimated cost $4,000,000.

B. C., New Westminster—Pacific Veneer Co., Ltd., Sapperton, New Westminster, will soon call for bids for the construction of an addition to its plant. Estimated cost, $52,000.

Ont., Amherstburg—Amherst Distillers, K. F. White, Mgr., Amherstburg, plans to rebuild portion of plant recently destroyed by fire and are in the market for new equipment. Estimated cost $50,000.

Ont., Kitchener—Dominion Rubber Co., 149 Strange St., is having plans prepared by J. C. Klaehm, Archt., 49 King St., for remodeling its existing buildings.

Ont., Thorold—Ontario Paper Co., Ltd., 14 Allanburg Rd., Thorold, plans to construct an addition to its plant. Estimated cost $100,000.

Ont., Toronto—Northern Diatomite Ltd., c/o S. A. Shoemaker, 302 Bay St., plans to construct a mining and refining plant. Estimated cost $50,000.

Ont., Toronto—Ontario Pyrites Co., Ltd., c/o B. V. McCrimmon, 80 West King St., plans to construct a manufacturing and mining plant. Estimated cost $50,000.

Ont., Windsor—Hiram Walker & Sons, Ltd., distillers, plans alterations to its plant. Estimated cost between $50,000 and $75,000.

Que., Quebec City—Dominion Oxygen Co., Ltd., 159 Bay St., Toronto, Ont., plans to construct an acetylene and carbide warehouse. Estimated cost including equipment, $165,739.

Sask., Moose Jaw—British American Oil Co., Ltd., Royal Bank Bldg., Toronto, Ont., plans to construct a plant. Estimated cost $250,000.

Sask., Regina—British American Oil Co., Ltd., Royal Bank Bldg., Toronto, Ont., plans to construct an addition to its plant here. Estimated cost $250,000.

CONTRACTS AWARDED

Calif., Asti—Italian Swiss Colony, Asti, plans to construct a plant consisting of three buildings for the manufacture of cream of tartar. Work will be done with own forces. Estimated cost will exceed $40,000.

California—Dow Chemical Co., 4151 Baudinia Blvd., Los Angeles, has awarded the contract for the construction of a plant to Stone & Webster Co., 601 West 5th St., Los Angeles. Estimated cost $5,500,000.

California—Goodyear Tire & Rubber Co., Akron, O., has awarded the contract for the construction of a plant to Ford J. Twaits Co., 451 South Boylston Ave., Los Angeles. Estimated cost $5,500,000.

Colorado—U. S. Engineer, c/o Postmaster, Denver, Colo., negotiations of letter of intent with E. I. DuPont de Nemours & Co., Wilmington, Del., to construct and operate plant here. Estimated cost will exceed $3,000,000.

Illinois and Texas—War Emergency Pipeline, Inc., B. E. Hull, Vice Pres., Little Rock, Ark., has awarded the contract for 550 mi. of oil pipeline from Longview, Tex., to Norris City, Ill., with two smaller branch lines from Norris City to Mt. Vernon, Ind., and Enfield, Ill., as follows: Longview, Tex., to Arkansas-Texas state line to Williams Bros. Corp., National Bank of Tulsa Bldg., Tulsa, Okla.**Arkansas-Texas state line to Gurdon, Ark., to O. E. Dempsey Construction Co., Kennedy Bldg., Tulsa, Okla.**Gurdon to Little Rock, Ark., (Arkansas River) to Anderson Bros., Tulsa, Okla.**Harrisburg to Norris City, Ill., and 14 mi. branch line from Norris City, Ill., to Mt. Vernon, Ind., to Sheehan Pipe Line Construction Co., National Bank of Tulsa Bldg., Tulsa, Okla.**Little Rock to Missouri-Arkansas state line (St. Francis River) to Oklahoma Contracting Co., Magnolia Bldg., Dallas, Tex.**St. Francis River to Illmo, Mo., (Mississippi River) to C. S. Foreman Co., New York Life Bldg., Kansas City, Mo.**Mississippi River to Harrisburg, Ill., to Ray E. Smith Construction Co., El Dorado, Kan. Total estimated cost $35,000,000.

La., St. Francisville—Warriner Starch Plant c/o D. Warriner, St. Francisville, will construct a sweet potato dehydrating plant. Work will be done by force account. Estimated cost $40,000.

Md., Relay—Jos. E. Seagram & Sons, Louisville, Ky., have awarded the contract for the construction of a 1 story, 100x170 ft. plant to Frantz Construction Co., 10 West Chase St., Baltimore. Estimated cost $70,000.

Mass., Cambridge—Dewey & Almy Chemical Co., 52 Whittemore Ave., has awarded the contract for the construction of a 1 and 2 story, 55x60x95 ft. plant along the railroad from Metropolitan and Ringe Aves., to L. O. Blake, 50 Dyer Ave., Milton, Mass.

N. J., Ridgefield—Corn Products Refining Co., 17 Battery Pl., New York, N. Y., has awarded the contract for the construction of a warehouse on Railroad Ave., here, to William J. Lange, Inc., 1617 51st St., North Bergen. Estimated cost $100,000.

North Carolina—National Carbon Co., Inc., 30 East 42nd St., New York, N. Y., has awarded the contract for the construction of a plant to Gillmore, Carmichael, Olsen Co., 1873 East 55th St., Cleveland, O. Total estimated cost $6,000,000.

Pennsylvania—Pennzoil Oil Co., Drake Theatre Bldg., Oil City, Pa., has awarded the contract for the construction of a manufacturing plant to Arthur G. McKee, 2300 Chester Ave., N. E., Cleveland, O. Estimated cost between $1,000,000 and $3,000,000.

Pennsylvania—Koppers United Co., Koppers Bldg., Pittsburgh, has awarded the contract for a plant to Rust Engineering Co., Clark Bldg., Pittsburgh. Estimated cost will exceed $5,000,000.

Utah—U. S. Engineer, 32 Exchange Pl., Salt Lake City, has awarded the contract for the construction of a chemical plant, to W. E. Callahan Construction Co., 714 West Olympic Blvd., Los Angeles, Calif. Estimated cost less than $3,000,000.

Sask., Alaska—Natural Sodium Products, Ltd., Bishopric, will construct a sodium sulphate plant by day labor. Estimated cost $100,000.